# ABSTRACTS OF NORTH AMERICAN GEOLOGY

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# ABSTRACTS OF NORTH AMERICAN GEOLOGY

## INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

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# ABSTRACTS

**Acaroglu, Ertan R.** *See* Graf, Walter H. 10846

**Adams, John A. S.** *See* Ragland, Paul C. 00706

00898 **Adegoke, Oluwafeyisola S.** Earliest Tertiary west American species of *Platyodon* and *Penitella*: California Acad. Sci. Proc., ser. 4, v. 35, no. 1, p. 1–22, illus., tables, 1967.

Species of boring bivalve molluscs belonging to the genera *Platyodon* Conrad and *Penitella* Valenciennes are rare in the Cenozoic record of the West Coast of North America. To date, five species have been recorded from Tertiary formations. Three new species, *Platyodon pecki, P. clarki, and Penitella durhami* are described. Western American Cenozoic and Recent records of species of the two genera, together with their presently known geographic and temporal ranges are given. The Japanese Miocene species of *Platyodon, P. nipponica* Uozumi and Fujie, is probably very closely related to *P. piedraensis* Wiedey from the Vaqueros Formation of San Luis Obispo region, Calif.—*from* Author's abstract

**Adkison, W. L.** *See* Johnson, William D., Jr. 00637

10911 **Aitken, J. D.** Middle Cambrian to Middle Ordovician cyclic sedimentation, southern Rocky Mountains of Alberta: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 405–441, 1966.

Shallow-water cratonic rocks of Middle Cambrian to Middle Ordovician age contain a limited number of cyclically repeated lithologies. The sequence is divisible into eight grand cycles, each of which comprises a lower, shaly half-cycle and an upper, carbonate half-cycle. Repetitions of lithologic sequences within a single grand cycle are termed rhythms, and the individual sequences whose repetition reveals the rhythm are termed sub-cycles. A "tilting craton theory" is proposed. Lower Paleozoic marine transgression is postulated to have taken place through pulsatory tilting of a craton about a horizontal axis combined with continuous slow subsidence of that axis.—C.A.S.

00802 **Aki, Keiiti.** Scaling law of seismic spectrum: Jour. Geophys. Research, v. 72, no. 4, p. 1217–1231, illus., table, 1967.

The dependence of the amplitude spectrum of seismic waves on source size is investigated on the basis of two dislocation models of an earthquake source. The theoretical curves are compared with observations. The model constructed by fitting an exponentially decaying function to the autocorrelation function of the dislocation velocity gives satisfactory agreement with observations, on the assumption of similarity. The efficiency of seismic radiation seems to increase with decreasing magnitude. The assumption of similarity implies a constant stress drop independent of source size; preliminary study of Love waves from the Parkfield earthquake of June 1966 shows that the stress drop at the source of that earthquake is much lower than normal.—D.B.V.

00675 **Akimoto, Syun-Iti; Komada, Eiji; Nushiro, Ikuo.** Effect of pressure on the melting of olivine and spinel polymorph of $Fe_2SiO_4$: Jour. Geophys. Research, v. 72, no. 2, p. 679–686, illus., tables, 1967.

Results of an investigation of the effect of pressure on the melting relations and polymorphism of $Fe_2SiO_4$ at pressures up to 76 kb, using the tetrahedral anvil type apparatus, suggest that a considerable inflection will be found in the melting curve of the Earth's mantle at a depth of 400 to 1,000 km.—D.B.V.

10766 **Albers, John P.** Economic deposits of the Klamath Mountains, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 51–62, illus., table, 1966.

The mineral deposits of the Klamath Mountains consist of chromite, asbestos and nickel in ultramafic igneous rocks and the serpentinite derived from them; gold, silver, copper, lead, zinc, pyrites, and iron deposits chiefly in metamorphosed sedimentary and volcanic rocks, and inferred to be genetically related to the intrusion of granitic rocks; quicksilver deposits inferred to be associated elsewhere with late volcanic activity; manganese; placer gold and platinum; and building materials concentrated by sedimentary processes. Gold is the principal mineral product of the area, and comes from three main sources: placers, lode deposits, and as a by-product of massive sulfide deposits mined chiefly for copper, and from gossan derived from the massive sulfide.—*from* Author's introduction

**Aldrich, L. T.** *See* Asada, T. 10697

**Aldrich, L. T.** *See* Smith, T. Jefferson. 10704

**Alexander, Robert H.** *See* Meier, Mark F. 10901

10924 **Am. Society for Testing and Materials.** Testing techniques for rock mechanics—Symposium presented at 5th Pacific Area Natl. Mtg., Seattle, 1965: Am. Soc. Testing Materials Spec. Tech. Pub. 402, 297 p., illus., tables, 1966.

The three sessions of the meeting were concerned with: an evaluation of laboratory tests on rock and description of apparatus used, description and analysis of *in situ* tests on rock formations, and applications and case histories. Individual papers and discussions are cited separately.—M.C.M.

**Anderson, Orson L.** *See* Schreiber, Edward. 00672

**Anderson, Orson L.** *See* Soga, Naohiro. 00784

00809 **Andrews, James E.** Blake Outer Ridge—Development by gravity tectonics: Science, v. 156, no. 3775, p. 642–645, illus., 1967.

A continuous seismic profile across the Blake Outer Ridge reveals clear evidence of a structural origin for the ridge. A ridge core separates distinctive regions of structure east and west of the crest and does not support a theory of depositional origin. The presence of horizon A continuously beneath the ridge rules out faulting or folding involving basement rocks. Gravity tectonics are suggested as the mechanism for formation of the ridge after the deposition of the sediments above horizon A.—Author's abstract

00733 **Angino, Ernest E.** Far infrared (500–30 $cm^{-1}$) spectra of some carbonate minerals: Am. Mineralogist, v. 52, nos. 1–2, p. 137–148, illus., tables, 1967.

Several well resolved major and minor bands are present in the far infrared spectra of the isomorphous members of the calcite and aragonite groups. The major absorption bands are probably diagnostic of the minerals. Shifts in frequency of certain lattice mode vibrations may be related to mass and radius differences of the cationic component of the carbonates, although effects attributable to cation substitution are not unambiguously demonstrated.—Author's abstract

**Annell, S. S.** *See* Cuttitta, Frank. 00777

00923 **Arnold, A. B.** The San Andreas fault crossings of the California aqueduct: Eng. Geology, v. 4, no. 1, p. 1–8, illus., 1967.

In southern California the California aqueduct crosses the San Andreas fault in four places. Two crossings are in the Antelope Valley near Palmdale, one is near Gorman, and one is on the south side of the San Bernardino Mountains. Geologic investigations of these areas consisted of mapping, drilling, soils sampling, excavating trenches, and geophysical surveys. A possible movement of 20 feet horizontally and 2 to 3 feet vertically was considered in the design of the crossings. Special features have been incorporated into the design of the crossings to make them as reliable as possible.—M.S.T.

10697 **Asada, T.; Aldrich, L. T.** Seismic observations of explosions in Montana, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 382–390, illus., tables, 1966.

Four unreversed seismic profiles have been obtained in Montana and northeastern Wyoming from explosions used by the University of Wisconsin for their more complete studies in the area. The results, since they are unreversed, can only place limits on the complex structure across the continental divide. Flat-lying models require a rather thick (35-km) layer of intermediate velocity (6.7 kmps) in northern Montana, which thins to the south and east. $P_n$ velocities are indeterminate from these profiles, since they are both unusual and unreversed.—Authors' abstract

**Asada, T.** *See* Hales, A. L. 10699

00892 **Ayers, H. D.; Ding, John Y. H.** Effects of surficial geology on streamflow distribution in southern Ontario: Canadian Jour. Earth Sci., v. 4, no. 2, p. 187–197, illus., 1967.

The dominant parent geological materials on the four pairs of watersheds on which streamflow distribution was investigated were: A, coarse-textured soils; B, moderately fine-textured soils formed on very fine sands and silts; C, medium textured soils formed on till; D, fine-textured soils formed on till. Larger amounts of ground-water recharge on watersheds of coarse-textured soils resulted in higher summer flows, more uniform seasonal flow, and reduced spring runoff extremes. The ground water daily recession constant was likewise higher for streams draining coarse-textured soils.—G.D.C.

10711 **Bacon, L. O.** Geologic structure east and south of the Keweenaw fault on the basis of geophysical evidence, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 42–55, illus., tables, 1966.

Gravity and magnetic data indicate that a Middle Range of basalt lavas lies beneath the Jacobsville sandstone and that it may be the north limb of a shallow, asymmetrical syncline plunging to the west at a low angle, with the South Range of basalt lava as the southern limb, or that the Middle Range lavas are a horst. The north side of the Middle Range lavas is interpreted as a fault contact downthrown to the north. Within the graben structure between the Keweenaw fault and the Middle Range fault there seems to be a third fault. All these faults appear to be cut by three or four cross faults, to account for local anomalies. The maximum thickness of the Jacobsville sandstone is of the order of 10,000 feet.—Author's abstract

10763 **Bailey, Edgar H.** (editor). Geology of northern California: California Div. Mines and Geology Bull. 190, 507 p., illus., tables, geol. map, 1966.

This bulletin is a compilation of the most recent geological information available on California. A chapter is devoted to the main geologic features of each of the major geologic provinces of the state, with supplementary shorter chapters for each province treating some aspects of particular geologic interest or of economic importance. Also included are an historical summary of State geologic maps, several articles on the San Andreas fault, and three chapters on the offshore area. Information on the crustal structure of northern California now available from gravity, magnetic, and seismic geophysical measurements is summarized in several

chapters. A series of roadlogs is included for guided or self-guided field trips.—M.S.T.

**Bailey, R. A.** *See* Smith, R. L. 10869

**Ball, R. H.** *See* Kahle, Anne B. 00876

10716 **Bally, A. W.; Gordy, P. L.; Stewart, G. A.** Structure, seismic data, and orogenic evolution of southern Canadian Rocky Mountains: Bull. Canadian Petroleum Geology, v. 14, no. 3, p. 337–381, illus., 1966.

The Rocky Mountain folded belt, 80 miles wide, is underlain by a gently dipping westward extension of the Precambrian shield. Shortening, exceeding 100 miles in Paleozoic beds, occurred along decollement zones and curved thrust faults that flatten westward at depth. Late Mesozoic and early Tertiary thrusting was followed by late Tertiary normal faulting. Reflection seismic data indicate that normal faults may merge at depth with older thrust faults, and suggest that the westward dip of the Precambrian basement continues farther west beneath and beyond the Rocky Mountain Trench. Palinspastic restorations are made on the basis of seismic and subsurface data.—C.A.S.

**Balmer, G. G.** *See* Barry, A. J. 10899

10708 **Bancroft, A. M.** Seismic spectra and detection probabilities from explosions in Lake Superior, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 234–240, illus., tables, 1966.

Velocity amplitude spectra were determined for 24 of the 78 explosions fired in Lake Superior in 1963. Many of these spectra display low-frequency peaks close to theoretical values calculated from water depths above the shots. The higher odd harmonics are often present. The probability of these shots' being detected by distant (>1,000 km) recording stations ranges from more than 70 percent (for shots fired in the depth range 130–160 m) to less than 10 percent (for shots fired at less than 70- or greater than 250-m depth).—Author's abstract

00840 **Banner, F. T.; Blow, W. H.** The origin, evolution, and taxonomy of the foraminiferal genus *Pulleniatina* Cushman, 1927: Micropaleontology, v. 13, no. 2, p. 133–162, illus., 1967.

Studies of many stratigraphic sections from late Miocene to Recent have allowed the origin and evolution of species of the genus *Pulleniatina* to be traced. The evolutionary sequence from *Pulleniatina primalis*, n.sp., to *P. obliquiloculata finalis*, n. subsp., is useful in biostratigraphy. *P. spectabilis* forms a separate evolutionary line and has a short Pliocene range in the Indo-Pacific province. *Pulleniatina* originates from *Globorotalia (Turborotalia) acostaensis* Blow, 1959; its holotype is re-illustrated. *Globigerina inflata* d'Orbigny, 1839, is unrelated to *P. obliquiloculata* s.l., and a neotype for the former taxon is proposed. The new monotypic genus *Rotaliatinopsis* is proposed to accomodate *"?Pulleniatina semi-involuta"* Germeraad, 1946.—M.S.T.

00894 **Barnes, Christopher R.** Stratigraphy and sedimentary environments of some Wilderness (Ordovician) limestones, Ottawa Valley, Ontario: Canadian Jour. Earth Sci., v. 4, no. 2, p. 209–244, illus., tables, 1967.

Limestones of the Pamelia, Lowville, Chaumont, and Rockland Formations were examined in this area; the lithostratigraphy and conodont biostratigraphy of the Chaumont were studied in detail. East of Ottawa, the latter is composed of uniform thick-bedded calcarenites, underlying similar Rockland limestones and overlying thin-bedded Lowville and Pamelia calcilutites. West of Ottawa, the Chaumont lithology includes Lowville-type calcilutites and reflects four regressive phases within overall transgression. In the overlying lower Rockland, cross-stratified calcirudites form wedge-shaped facies thickening westward. Indicated paleoenvironments for the four formations are analogous to modern carbonate banks; diachronous lateral

facies are postulated. The conodont biostratigraphic evidence in the Chaumont is sufficiently detailed to settle the controversy.—G.D.C.

**Barnes, Harley.** *See* Byers, F. M., Jr. 00838

**Barnes, I. L.** *See* Funkhouser, J. G. 10863

**Barnes, Robert H.** *See* Wilson, Charles W., Jr. 00824

00917 **Barnes, Virgil E.** Geologic map of the Cave Creek School quadrangle, Gillespie County, Texas: Texas Univ. Bur. Econ. Geology Geol. Quad. Map 32, scale 1:24,000, separate text, 1967.

Cave Creek School quadrangle is high on the southeastern side of the Llano uplift; Precambrian, Cambrian, and Ordovician rocks crop out in patches in the southern and eastern parts, and Cretaceous rocks and Quaternary surficial deposits occupy the remainder. Numerous faults are related to the subsurface Ouachita structural belt and trend NE–SW and EW. Mineral resources are limited to construction materials—dimension and crushed stone, sand and gravel, and road material. Main aquifers are Hensell Sand and the lower part of Hickory Sandstone.—M.C.M.

00918 **Barnes, Virgil E.** Geologic map of the Yeager Creek quadrangle, Blanco County, Texas: Texas Univ. Bur. Econ. Geology Geol. Quad. Map 34, scale 1:24,000, separate text, 1967.

Cretaceous rocks and small Quaternary surficial deposits occupy Yeager Creek quadrangle, located high on the southeast side of the Llano uplift. In the northern part, the relatively flat-lying Cretaceous rocks have an average dip eastward of about 20 feet per mile, interrupted by a fault to the south. Mineral resources are limited to construction materials—dimension and crushed stone, sand and gravel, and road material. Inventoried wells are situated on Glen Rose Limestone and alluvium. Some ground water is high in sulfate and unsuitable for domestic use. Springs are randomly distributed; those analyzed furnish good quality water.—M.C.M.

10893 **Barnett, D. M.** A re-examination and re-interpretation of the gauge data for Churchill, Manitoba: Canadian Jour. Earth Sci., v. 3, no. 1, p. 77–88, illus., table, 1966.

Tide gauge data from Churchill, Manitoba, for the period 1928–1939 are reviewed and rejected as inaccurate. The rate of uplift proposed by Gutenberg on the basis of these data therefore is rejected also. Data from 1940 to 1964 are subjected to statistical analysis, which indicates an apparent lowering trend of water level. Linear regression suggests a rate of 2 feet per century. Allowance for eustatic rise in sea level yields a rate of crustal uplift of 2.40 feet per century.—D.M.B.

00817 **Barraclough, Jack T.** Ground-water features in Escambia and Santa Rosa Counties, Florida: Florida Board Conserv. Div. Geology Map Ser., no. 26, scale about 1 in. to 10 mi., text, 1967.

The map sheet includes bar graphs on rainfall and average daily use of ground water, sections showing aquifers and aquicludes, and the following maps: tops of lower limestone of Floridan aquifer, Pensacola Clay, and beds in the sand-and-gravel aquifer that contain sea shells; thickness of sand-and-gravel aquifer and average pumping wells of larger well fields; mineral content of water from upper part of sand-and-gravel; chloride and fluoride content of water from upper limestone of the Floridan; and general areas of water availability in sand-and-gravel. The Floridan can furnish moderate to large quantities of water especially in the northern half of the two counties.—M.C.M.

10880 **Barringer, A. R.; Schock, J. P.** Progress in the remote sensing of vapours for air pollution, geologic and oceanographic applications, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 779–791, illus., 1966.

Extensive applications exist for sensitive equipment capable of detecting a range of gases and vapors from survey aircraft and orbiting spacecraft. New possibilities exist for applying vapor detection to various geologic exploration problems and research. Instrumentation is described which is capable of remotely sensing vapor concentrations in the part per billion range. The equipment utilizes dispersive optics in conjunction with special correlation masks matched to the appropriate spectra, and a single unit can be programmed to detect a number of gases. Potential orbital applications for the geochemical study of planetary atmospheres are discussed.—*from* Authors' abstract

10887 **Barringer, A. R.** The use of multi-parameter remote sensors as an important new tool for mineral and water resource evaluation, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 313–325, illus., 1966.

The requirement for greatly improved methods of exploration for natural resources is discussed in relation to the expanding demands for raw materials. A new approach is suggested involving the use of multiple remote sensors in aircraft on a regional or national scale in order to assist in the production of high quality geologic maps. Examples are given of the joint use of electromagnetic, magnetic and radiometric airborne survey equipment. The application to water resource problems is demonstrated and the latest advances in airborne systems with digital readout and computerized data reduction are discussed.—Author's abstract

**Barringer, A. R.** *See* Holdsworth, D. W. 10888

10899 **Barry, A. J.; Poncelet, E. F.; Balmer, G. G.; Deklotz, E. J.** Discussion [of "Foundation testing techniques for arch dams and underground powerplants," by G. B. Wallace and O. J. Olsen, 1966], *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 290–291, 293, 294–297, illus., 1966.

This is a discussion of terms and techniques used in the original paper (ibid., p. 272–289) for making various strength of rock tests and calculating other properties of rocks from these experiments.—M.S.T.

10717 **Barsanov, G. P.; Kolesnikov, L. V.** O magnitnykh svoystv franklinita: Akad. Nauk SSSR Doklady, v. 171, no. 1, p. 173–176, illus., tables, 1966.

Thermomagnetic measurements were made on six samples of franklinite from Franklin Furnace, N. J. Franklinite is made up of three components: $FeFe_2O_4$ and $MnFe_2O_4$ which are ferromagnetic with Curie points of 575°C and 300°C, respectively, and $ZnFe_2O_4$ which is paramagnetic. Variation in the magnetic properties of franklinite is due to variation in the proportions of these constituents. The results agree with Ramdohr's report of microscope observations of structures of solid solution breakdown in franklinite, and suggest that Mason's assumption of unlimited miscibility in the field of the cubic phase of this system is erroneous.—D.B.V.

10806 **Bartenstein, Helmut.** "Scharrkreise" an einer senkrechten Sandwand: Natur u. Mus., v. 96, no. 4, p. 155–156, illus., 1966.

Scarified circular markings in horizontal tidal flat sediments have been reported before, and attributed to scratching by rooted plant stems moving around under wind action. Such a marking is cited and illustrated in a vertical wall of a sand pit in a consolidated, fine-grained Pleistocene dune sand of the Wichita Mts., Oklahoma. The mark is 1.5–2 m in diameter. The stripping and fossil preservation of the mark is attributed to action of the plant during a cyclonic storm, during which there was heavy rain and local mud flow.—M.G.

10768 **Bateman, Paul C.; Wahrhaftig, Clyde.** Geology of the Sierra Nevada, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 107–172, illus., tables, 1966.

A comprehensive review is given of the geologic history and structure of the Sierra Nevada Range, a huge crustal block that has been tilted westward, and overlapped on the west by sediments of the Great Valley and on the north by volcanic sheets from the Cascade Range. Most of the south half and the northeastern part are composed of plutonic rocks, chiefly granitics of the Mesozoic Sierra Nevada batholith. In the north half of the range the batholith is flanked on the west by the western metamorphic belt, a region of strongly deformed and metamorphosed sediments and volcanics of Paleozoic and Mesozoic age. The Mother Lode passes through the heart of this belt. The batholith extends eastward to the east edge of the range.—M.S.T.

10843 **Bauer, Albert.** Le bilan de masse de l'Indlandsis du Groenland n'est pas positif [with English abs.]: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 4, p. 8–12, 1966.

The synopsis of glaciological observations of the Greenland ice sheet, published by H. Bader in 1961, yields a positive mass budget. However, according to a more recent calculation, the mass budget is negative. Recent observations confirm this conclusion.—Author's abstract

10917 **Beaven, P. J.; Dumbleton, M. J.** Clay minerals and geomorphology in four Caribbean islands: Clay Minerals, v. 6, no. 4, p. 371–382, tables, 1966.

Clay mineral analyses of Caribbean soils [from Trinidad, Jamaica, Granada, and Barbados] illustrate the differences in composition that can arise from differences in topography and parent material, and emphasize the differences between the groups of proposed new engineering classifications of the soils based on these factors. Within one set of environmental conditions the clay mineral assemblage was reasonably constant. Examples are given of local differences in clay type which were correlated with variations in climate and mode of formation.—Authors' abstract

10675 **Bednarek, A. R.; Meyer, R. P.** Comparison of time term and $P_n$ residual methods of interpreting first arrivals from the Lake Superior experiments, *in* The earth beneath the continents— . . . geophysical studies in honor of M. A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 276–289, illus., tables, 1966.

$P_n$ residual times for seven distant stations of widely varying azimuths from Lake Superior shot points are compared with time terms given by Berry and West [1966]. For shots on the eastern three-quarters of the lake, reduced travel and $P_n$ time terms differ by the time term of the recording station. For shots in the western quarter, reduced traveltimes for six of seven stations diverge gradually from $P_n$ time terms with maximum at the western end of the lake. Near Madison, Wis., divergence is of the order of 4.5 sec; for all stations it averages 3 sec. Evidence indicates divergence is real and the source near the western part of the lake. Reduced times for shots close to Keweenaw Peninsula increase as compared with those at greater distances; decrease in $P_n$ velocities in this vicinity and local structure may be contributors.—*from* Authors' abstract

00826 **Bell, D. D.** Nuclear fuel resources and price trends: Canadian Mining and Metall. Bull., v. 60, no. 660, p. 450–456, 1967.

This paper presents the history of uranium procurement and demand, and a look at future requirements. The three basic conclusions drawn are: (1) the productive capacity of former and existing producers whose operations may be profitably reactivated is insufficient to meet demand projected beyond 1975; (2) reserves in the five and ten dollar price range do not provide the flexibility to sustain production at the high rates required in the late 1970's; and (3) only higher prices can overcome these deficiencies, and this would provide sufficient inducement for the industry to explore for and develop new reserves and productive capacity.—Author's abstract

00916 **Bennett, G.; Brown, D. D.; George, P. T.; Leahy, T.** Hearst sheet, Districts of Cochrane and Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 397, scale 1 in. to 2 mi., 1967.

00924 **Bennett, G.; Brown, D. D.; George, P. T.; Leahy, E. J.** Kapuskasing sheet, Districts of Cochrane and Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 398, scale 1 in. to 2 mi., 1967.

00943 **Bennett, G.; Brown, D. D.; George, P. T.; Leahy, T.** Pivabiska River sheet, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 395, scale 1 in. to 2 mi., 1967.

00944 **Bennett, G.; Brown, D. D.; George, P. T.** Little Long Rapids sheet, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 396, scale 1 in. to 2 mi., 1967.

**Bennett, H. J.** *See* Everett, F. D. 00872

**Bennett, Richmond.** *See* Livingston, Donald E. 00680

00701 **Berger, Wolfgang H.** Foraminiferal ooze—Solution at depths: Science, v. 156, no. 3773, p. 383–385, illus., tables, 1967.

Samples of foraminiferal ooze were exposed to ocean water at various depths for four months, attached to the taut wire of a buoy in the central Pacific. Appreciable solution took place below 1,000 m and increased rapidly below 3,000 m and below 5,000 m. The fact that samples from different locations appear to dissolve at different rates suggests that the previous history of a sample determines its solubility. Solution is selective; it changes species composition, size distribution, content of damaged shells, and average particle weight of an assemblage.—Author's abstract

**Bermúdez, Pedro J.** *See* Seiglie, George A. 10877

10907 **Berry, D. S.; Fairhurst, Charles.** Influence of rock anisotropy and time dependent deformation on stress-relief and high-modulus inclusion techniques of *in situ* stress determination, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 190–206, illus., table, 1966.

Two of the most popular techniques used in the determination of *in situ* rock stresses are the stress relief and high-modulus inclusion methods. This paper presents a theoretical analysis of the influence of: (a) rock anisotropy, of the transversely isotropic kind, on the accuracy of values of *in situ* stresses determined from the usual isotropic analysis and (b) time-dependent rock deformation, represented as linear, isotropic, viscoelastic creep, on the stresses developed in high-modulus plugs. It is shown that significant errors (over 50 percent for one stress-relief example chosen) may be introduced by neglecting these factors.—*from* Authors' abstract

**Berry, Frederick A. F.** *See* Levorsen, A. I. 00791

10700 **Berry, M. J.; West, G. F.** Reflected and head wave amplitudes in a medium of several layers, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 464–481, illus., 1966.

Heelan's and Brekhovskikh's short-wavelength, asymptotic theory for the elastic waves reflected and critically refracted by a single interface has been extended to the case of several plane, parallel layers overlying a half-space. Formulas are derived from which may be calculated the amplitude of the surface motion due to a wave that has traveled via a specified ray path from a point P-wave source. Consistent formulas for the head wave, reflected and refracted wave, and surface motion coefficients are given, as well as graphs of the head wave coefficients. Theoretical amplitudes calculated for a structural model proposed by Roller to interpret a crustal refraction survey on the Colorado Plateau are found to agree reasonably well with Roller's observed amplitudes.—Authors' abstract

10703 **Berry, M. J.; West, G. F.** A time-term interpretation of the first-arrival data of the 1963 Lake Superior Experiment, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union

Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 166–180, illus., tables, 1966.

Results of interpretation of first arrival data of the Lake Superior experiment by the time–term method, appear to be consistent and meaningful. The traveltime curves divide into two linear segments, and the solution based on data from the outer section has been named the Mohorovicic solution and those based on the other data, the upper refractor solutions. Materials beneath the upper refractor and the M–discontinuity have velocities of 6.63 and 8.10 kmps, respectively. The surface of the upper refractor is undulating, and is close to the surface at the edges of the lake and at maximum depth east and west of the Keweenaw Peninsula. The M–discontinuity dips eastward from a depth of 35 km at the west end of the lake and 60 km just west of the Keweenaw Peninsula. Eastward, time–term values fluctuate.—E.S.L.

00654 **Best, Myron G.; Hamblin, W. K.; Brimhall, Willis H.** Preliminary petrology and chemistry of Late Cenozoic basalts in the western Grand Canyon region: Brigham Young Univ. Geology Studies, v. 13, p. 109–123, illus., tables, 1966 [1967].

Although the lavas in this region of northern Arizona and adjacent Utah are all essentially alkali olivine basalts, considerable and significant variations in their mineral and chemical composition allow discrimination of at least six basalt types, ranging from a mafic basalt rich in olivine and clinopyroxene, with 45 wt percent silica, to basalts carrying xenocrysts of complexly zoned plagioclase and quartz, with 52 wt percent silica. Gamma–ray spectrometry discloses as much as 1.5 percent K, 11 ppm Th, and 3 ppm U in some types, and in others much lower values near average worldwide alkali olivine basalts. Ultramafic inclusions containing partially decomposed orthopyroxene are unique to the youngest basalt flows in the southeastern part of the region. Several primitive or parental magmas are indicated.—G.D.C.

**Billings, Gale K.** *See* Ragland, Paul C. 00706

00884 **Birkhead, Paul K.** Stromatoporoidea of Missouri: Bulls. Am. Paleontology, v. 52, no. 234, p. 23–110, illus., 1967.

Thirty–five species of stromatoporoids from the Silurian Edgewood and Sexton Creek Formations and the Devonian Grand Tower, Callaway, and Snyder Creek Formations of Missouri are described; twenty–eight are new. All Silurian species belong to the genus *Clathrodictyon*, in which the evolutionary trends noted are development of true laminae and pillars, thicker pillar and laminar tissue, and definite atrorhizae. The abundance of stromatoporoid species in the Callaway Formation made possible a comparison of its fauna with stromatoporoid faunas of other regions.—M.S.T.

**Blanchard, J. E.** *See* Dainty, A. M. 10687

**Blanchard, J. E.** *See* Keen, M. J. 10742

00841 **Blank, H. Richard, Jr.; Mackin, J. Hoover.** Geologic interpretation of an aeromagnetic survey of the Iron Springs district, Utah: U.S. Geol. Survey Prof. Paper 516–B, p. B1–B14, illus., geol. map, 1967.

Isomagnetic contours on a total–intensity aeromagnetic map overprinted on a generalized geologic map roughly delineate three exposed bodies of quartz monzonite porphyry—Three Peaks intrusion extending at shallow depth beneath alluvium east and southeast; Granite Mountain, an upbulge on a largely concealed intrusive body extending north, west, and southwest; and some evidence for a considerable western extension of the Iron Mtn. intrusion. The zone of "selvaged" joints beneath peripheral rock of the Three Peaks has a higher susceptibility than normal interior rock and produces a local magnetic high superimposed on the anomaly's general pattern. Amplitude of the high appears to be proportional to size and abundance of magnetite veins and joint coatings characteristic of this zone. Some contact–replacement orebodies also produce strong local anomalies; others were not detected by the survey.—*from* Authors' abstract

**Blow, W. H.** *See* Banner, F. T. 00840

**Blumer, M.** *See* Clark, R. C., Jr. 00846

00661 **Boettcher, A. L.; Wyllie, P. J.** Revision of calcite-aragonite transition, with the location of a triple point between calcite I, calcite II and aragonite: Nature, v. 213, no. 5078, p. 792–793, illus., 1967.

A revised phase diagram is presented for the system calcium carbonate. A triple point is located at 9.4 kb pressure and 480°C. The revised diagram provides a large pressure-temperature area for metastable crystallization of aragonite, which includes the near-surface conditions where aragonite is known to grow and also the low-grade metamorphic conditions where the formation of aragonite has been reported; this large region for metastable aragonite at moderate temperatures and low pressures raises doubts concerning the validity of the aragonite-calcite I transition boundary as a geobarometer.—D.B.V.

10908 **Boettcher, A. L.** Vermiculite, hydrobiotite, and biotite in the Rainy Creek igneous complex near Libby, Montana: Clay Minerals, v. 6, no. 4, p. 283–296, illus., tables, 1966.

Vermiculite and hydrobiotite both occur as alteration products of biotite pyroxenite near Libby, Mont. Hydrothermal and weathering studies and new chemical analyses by C. O. Ingamells suggest that the vermiculite is a product of leaching by ground waters; the hydrobiotite may be a higher temperature alteration product.—Author's abstract

00684 **Bogard, D. D.** Krypton anomalies in achondritic meteorites: Jour. Geophys. Research, v. 72, no. 4, p. 1299–1309, illus., tables, 1967.

The Kr isotopic composition was measured in seven high-Ca and five low-Ca achondrites and in the high-Ca stony phase of one mesosiderite. The eight high-Ca samples contained large excesses of the Kr isotopes 80, 82, 83, and 84 compared with atmospheric amounts. This excess appears to correlate positively with exposure age. When the Kr excesses are normalized to Kr-82 = 1.00, a clear pattern emerges. The average relative excesses of cosmogenic Kr in the eight high-Ca samples for masses 80, 82, 83, and 84 were $0.61 \pm 0.08$, 1.00, $1.04 \pm 0.12$, and $0.78 \pm 0.23$, respectively. The low-Ca meteorites had lower Kr excesses, and two of them appeared to have excess Kr-80 and -82 from n,$\gamma$ reactions on Br. Small amounts of fission-produced Kr-86 may be present in achondrites with high U content.—D.B.V.

10780 **Bold, W. A. van den.** Ostracoda from Colón Harbour, Panama: Caribbean Jour. Sci., v. 6, nos. 1–2, p. 43–64, illus., table, 1966.

Seventy-eight species of ostracodes are listed from recent deposits in Las Minas Bay, Panama, and from Colón Harbour, localities in which G. S. Brady described (1869) 18 species of ostracodes. Forty-seven of the species are figured, 15 are briefly discussed, 6 are described in more detail; one of the latter is chosen as type species of a new genus, *Reussicythere*. One new species *Ruggieria dictyon*, is described. A neotype has been selected for *Orionina serrulata* (Brady).—*from* Author's abstract

00742 **Bond, T. A.** An Upper Eocene silicified reef deposit from Screven County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 89, 1967.

00847 **Bonham, H. F.** Gold producing districts of Nevada: Nevada Bur. Mines Map 32, scale 1:1,000,000, 1967.

Mining districts are listed by counties; production is shown on the map in ounces. This map supersedes Nevada Bur. Mines Map 11, 1962.—M.C.M.

00848 **Bonham, H. F.** Silver producing districts of Nevada: Nevada Bur. Mines Map 33, scale 1:1,000,000, 1967.

Producing districts are listed by counties; production is shown on the map in ounces of silver. This map supersedes Nevada Bur. Mines Map 12, 1962.—M.C.M.

10743 **Bonilla, M. G.; Schlocker, Julius.** Field trip—San Francisco Peninsula, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 441–452, illus., 1966.

The author outlines a field trip of the San Francisco Peninsula, starting in San Francisco, following the edge of the Peninsula from Telegraph Hill on the northeast to Fort Point on the north, and the Cliff House on the west. The route is then south along the Pacific Ocean, across the San Andreas fault zone near its junction with the coastline, to Half Moon Bay. The Santa Cruz Range is crossed along Pilarcitos Creek and the San Andreas fault zone is followed northwestward for about ten miles. Most of the Franciscan formation as well as the ultramafics which intrude it, and the younger rocks which cover it are seen.—M.S.T.

00931 **Boniwell, J. B.** Some recent results with the INPUT airborne EM system: Canadian Mining and Metall. Bull., v. 60, no. 659, p. 325–332, 1967.

The INPUT electromagnetic prospecting system was originally developed by Dr. A. R. Barringer in an effort to increase the sensitivity and penetration of airborne EM methods. Although brought to an operational state some several years ago, it is only through relatively recent modifications and testing that some of the potential of the system has been fully realized. This is brought into perspective by some recent results over known ore deposits and geologic environments.—Author's abstract

00698 **Borg, Iris; Handin, John.** Torsion of calcite single crystals: Jour. Geophys. Research, v. 72, no. 2, p. 641–669, illus., tables, 1967.

The torsion test was applied to single crystals of calcite in an attempt to discover potential slip systems not previously observed. The results merely confirmed Turner's systems, though *r* twinning is found here to be an important rather than a subsidiary mechanism. This investigation does demonstrate that analysis of twisted crystals is a powerful tool for identifying slip systems.—D.B.V.

00724 **Boss, B. D.** Differential thermal analysis of biotitic vermiculite to determine vermiculite content: Am. Mineralogist, v. 52, nos. 1–2, p. 294–298, illus., tables, 1967.

Vermiculite content can be rapidly estimated by comparison of the areas of the "third" endotherms for a sample and a reference vermiculite, each of which has been equilibrated with the same relative humidity.—B.C.H.

10777 **Bowen, A. J.; Inman, D. L.** Budget of littoral sands in the vicinity of Point Arguello, California: U.S. Army Corps Engineers Coastal Eng. Research Center Tech. Memo. 19, 41 p., illus., tables, 1966.

Results of a detailed analysis of the various littoral processes which affect the California coast between Pismo Beach and Santa Barbara are shown in graphic and tabular form. Each process is examined to assess sedimentary contributions and losses, the budget concept based on transport rates. To balance sediment transports, the region is subdivided by five positions where longshore transport of sand has been estimated; for each cell a quantitative rate was determined, using basic data from maps, surveys, aerial photographs, climatic records, and wave conditions. This budget concept provides a practical tool for coastal engineering problems, but the difficulty of moving from qualitative trends to quantitative determinations reveals gaps in the present state of knowledge and needs for further research.—G.D.C.

00798 **Bowie, S. H. U.** Commission on ore microscopy (I.M.A.): Econ. Geology, v. 62, no. 2, p. 278–282, 1967.

Secretary's minutes of meetings in Cambridge, August and September, 1966, report progress on reflectivity standards, tables, polishing methods, and other business.—W.S.W.

10810 **Bowin, Carl.** Gravity over trenches and rifts, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 430-439, table, 1966.

Mid-ocean ridges and deep trenches are the most prominent features of ocean basins, and both have been explained by investigators as resulting from convection in the mantle. Some aspects of these interpretations are examined. Ridges are in nearly isostatic equilibrium (free-air anomaly values are generally less than 50 mgal), but trenches have very large negative free-air anomaly values and are considerably out of isostatic equilibrium. The Puerto Rico Trench has the largest free-air anomaly so far measured on the Earth's surface (-380 mgal). A comparison of the Gulf of California, and the Cayman Trough is made. Assuming a tensional origin for these features, it is concluded that between 40 and 100 km of separation appear to be necessary before dense substratum begins to rise upward beneath the trough or rift.—Author's abstract

10791 **Bowin, Carl O.** Geology of central Dominican Republic—A case history of part of an island arc, *in* Caribbean geological investigations: Geol. Soc. America Mem. 98, p. 11-84, illus., tables, geol. map., 1966.

Metamorphosed pre-Albian(?) rocks, in a northwest-trending belt, are of two distinct types: volcanic and keratophyric of the Duarte and Maimon Formations, overlain by Siete Cabezas basalts and Peravillo andesite and tuff, and separated by serpentinized peridotite in a fault zone. The oldest dated rocks are Lower Cretaceous: first volcanic extrusions of the Los Ranchos Formation, then Hatillo Limestone, and fine tuffs of the Las Lagunas Formation. On the eroded surface named formations of late Maestrichtian age lie unconformably, followed by conformable Paleocene-Eocene clastics and tuff. Eocene volcanism and uplift are in marked contrast to limestone in northern and southern parts of the island. Major faulting and northeastward thrusting occurred in late Eocene time; deep basins north and south of Cordillera Central are filled with Oligocene sediments.—G.D.C.

00797 **Boyle, R. W.; Dass, A. S.** Geochemical prospecting—Use of the A horizon in soil surveys: Econ. Geology, v. 62, no. 2, p. 274-276, illus., 1967.

In surveys at Cobalt, Ontario, samples of A horizon showed larger and more sharply defined anomalies for the trace metals, As, and Sb, than samples from B horizon. Concentrations in the A horizon are presumably built up by accumulation of the trace elements in many generations of leaves and needles. Results of A-horizon sampling must be interpreted with caution.—W.S.W.

10744 **Brabb, Earl E.; Maddock, Marshall E.; Wallace, Robert E.** Field trip—San Andreas fault from San Francisco to Hollister, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 453-464, illus., 1966.

The route of this trip follows and partly crisscrosses a 100-mile segment of the San Andreas fault extending from San Francisco south to the Almaden winery, eight miles south of Hollister. Geomorphic features associated with the fault, such as sag ponds and scarps, offset tree rows, and springs, can be seen. Some of the destruction caused by movement along the fault in 1906, 1957, and 1963 can be observed.—*from* Authors' introduction

**Brace, W. F.** *See* Walsh, J. B. 10826

**Brace, W. F.** *See* Walsh, J. B. 10929

**Braddock, W. A.** *See* Hedge, Carl E. 00687

**Bradshaw, R. L.** *See* McClain, W. C. 00806

00786 **Brett, Robin.** Cohenite—Its occurrence and a proposed origin: Geochim. et Cosmochim. Acta, v. 31, no. 2, p. 143–159, illus., 1967.

On the basis of phase diagrams and kinetic data it is proposed that cohenite cannot form in meteorites having more than 8 weight percent Ni, and that any cohenite formed in meteorites with Ni content lower than 6 weight percent decomposed during cooling. Carbon in iron meteorites may be partly responsible for the supercooled nucleation of kamacite in meteorites proposed recently. Cohenite in meteorites probably formed over the temperature range 650°–610°C; the greater the C or Ni content, the lower the temperature of cohenite formation. The presence of cohenite indicates neither high nor low pressures of meteorite formation, but its absence in meteorites containing metal+graphite requires low pressures during cooling.—D.B.V.

**Brew, David A.** *See* Loney, Robert A. 00690

**Brimhall, Willis H.** *See* Best, Myron G. 00654

00707 **Brindley, G. W.; Sharp, J. H.; Patterson, J. H.; Narahari Achar, B. N.** Kinetics and mechanism of dehydroxylation processes—[Pt.] 1, Temperature and vapor pressure dependence of dehydroxylation of kaolinite: Am. Mineralogist, v. 52, nos. 1–2, p. 201–211, illus., tables, 1967.

Isothermal dehydroxylation of kaolinite at 400–540°C and with controlled water vapor pressures from $<10^{-2}$ mm Hg to 175 mm Hg conforms with a single curve of $\alpha$(fraction reacted) vs. $t/t_{50}$, where $t_{50}$ is the time for 50 percent reaction, agreeing with the supposition that the reaction is diffusion controlled. The reaction rate constant depends on both the temperature and the ambient water vapor pressure. The activation energy, 51 kcal/mole at $<10^{-3}$ mm Hg, increases to 112 kcal/mole at 47 mm Hg. The rate constant diminishes with vapor pressure according to an equation of the type $\log (1-k_p/k_0)=m+n \log P$, where m and n are temperature-dependent parameters, which is interpreted in terms of a partial coverage of the dehydroxylating surface by chemisorbed water molecules.—*from* Authors' abstract

10927 **Brindley, G. W.** Ethylene glycol and glycerol complexes of smectites and vermiculites—Invited review: Clay Minerals, v. 6, no. 4, p. 237–259, illus., tables, 1966.

Increasing attention has been given as to how these complexes vary with the nature of the mineral, magnitude and source of the silicate layer charge, and number and kind of exchangeable cations. The writer concludes that adequate answers concerning their nature cannot possibly be given. In their established organization between silicate layers, vermiculites tend to form single and smectites double layers. Basal spacings are meaningful only on regular structures; data based on disordered complexes should be indicated. Minerals inherently inhomogeneous are unsuitable for basic studies of organic complexes. Little has been done at various temperatures and pressures; the most difficult parameter to control is the magnitude and source of layer charge. Methods used to relate organic content to surface area may be better suited to comparisons than to absolute determinations.—G.D.C.

10805 **Brock, B. B.** Island arcs and their size-shape significance, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–15, p. 376–386, illus., table, 1966.

The degree of curvature of an island arc can be matched by other arcuate structures (oceanic ridges, mountain arcs, rift zones) whose shapes are controlled by size of elliptical or polygonal cratonic blocks which they bound. Linear island groups without visible curvature are taken to be the shared polygonal side of two contiguous and nearly identical rigid plates. On this basis a plausible subdivision of the Pacific floor is suggested. The size-shape groups of rigid plates of which island arcs are partial sutures each belong to a specific structural mosaic. Usually any mosaic can be divided into finer mosaics in the manner of a hierachy; island arcs and chains are one manifestation of this characteristic. The size-classification constitutes a refinement on the shape-classification and the two together permit a degree of

prognostication which would otherwise be difficult or impossible.—*from* Author's abstract

10930 **Brockamp, B.; Kohnen, H.** Ein Beitrag zu den seismischen Untersuchungen auf dem Grönlandischen Inlandeis [with English abs.]: Polarforschung 1965, v. 35, no. 6, pts. 1–2, p. 2–12, illus., tables, 1966.

The compressional and the shear wave velocities in the Greenland ice sheet are derived from seismic records of the EGIG 1959; the variation of velocities in the firn and the dependence of Poisson's ratio on depth are determined. Velocities of two P-waves recorded from underground layers at Station Centrale show that crystalline rocks form the basement. The P-wave velocities derived from reflections agree well with those obtained by refraction shooting, and, thus, indicate that the ice is homogeneous and isotropic for P-waves. The elastic constants for isotropic ice are calculated. Finally the temperature dependence of the velocities is discussed.—*from* Authors' abstract

00816 **Brookins, Douglas G.** Kansas kimberlites: Earth Sci., v. 20, no. 3, p. 109–114, illus., tables, 1967.

Five kimberlite pipes, aligned along certain joints in Riley County, Kansas, forming four topographic highs and one low, resemble kimberlites from elsewhere in the world. Inclusions consist of local Permian limestones and shales (unaltered), Precambrian schists and gneisses, and ultrabasic nodules. Primary and secondary minerals, exclusive of those in inclusions, are described briefly, but no diamonds have been found; assemblages indicate very high pressures and temperatures of formation. Both primary and secondary carbonate minerals look alike, but differing strontium content suggests genetic relationship between carbonatites and kimberlites. Indication by radiometric ages for low temperature of injection is consistent with lack of alteration noted in inclusions.—G.D.C.

**Brown, D. D.** *See* Bennett, G. 00916

**Brown, D. D.** *See* Bennett, G. 00924

**Brown, D. D.** *See* Bennett, G. 00943

**Brown, D. D.** *See* Bennett, G. 00944

**Brown, J. W.** *See* Deklotz, E. J. 10823

00638 **Brown, Robert D., Jr.** (and others). The Parkfield-Cholame, California, earthquakes of June–August 1966—Surface geologic effects, water-resources aspects, and preliminary seismic data: U.S. Geol. Survey Prof. Paper 579, 66 p., illus., tables, 1967.

This summary of surface effects, preliminary seismic data, and effects on water resources of the Parkfield–Cholame earthquakes of June–August 1966 consists of five separate chapters dealing with surface fractures along the San Andreas fault, rates and patterns of deformation, engineering geology, water-resources aspects, and instrumental seismic studies by Brown and Vedder, Wallace and Roth, Yerkes and Castle, Waananen and Page, and Eaton, respectively; all are cited separately.—V.S.N.

00639 **Brown, Robert D., Jr.; Vedder, J. G.** Surface tectonic fractures along the San Andreas fault, *in* The Parkfield-Cholame, California, earthquakes of June–August 1966: U.S. Geol. Survey Prof. Paper 579, p. 2–23, illus., tables, 1967.

Seven earthquakes, of M = 3.5–5.5, occurring during a 45-hr period from June 27–29, 1966, were among the largest of a complex succession which began with two light foreshocks on June 27 and continued to August in the Parkfield–Cholame area, Calif. Accompanying faulting caused surface fractures along a 23 1/2-mi segment of the main trace of the San Andreas fault and also a nearby subordinate fault within the major zone. The fractures follow earlier well-defined fault traces which have been the site of repeated movements, documented for over 100 years. Sense

of movement along both zones was right lateral. It is suggested that development of extensive tectonic fracturing accompanying these earthquakes of moderate magnitude is related to shallowness of the epicenters. Different parts of the fracture zones seem to have formed at different times; once formed they have undergone continued deformation.—V.S.N.

**Brownlow, Arthur H.** *See* Mantei, Erwin J. 00694

10811 **Brune, James N.** Regional variations in the structure of the upper mantle and the propagation of the Sa phase, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 441-444, 1966.

Regional variations in the velocity of Sa indicate high velocities in the upper mantle under shield areas. This result is in agreement with results from fundamental mode Rayleigh and Love waves and with results from P-wave delay time studies. Author's abstract

10874 **Bryan, W. B.** History and mechanism of eruption of soda-rhyolite and alkali basalt, Socorro Island, Mexico: Bull. Volcanol., v. 29, p. 453-479, illus., 1966.

Two major periods of volcanism can be recognized on Socorro Island, located on the Clarion Fracture Zone in the east Pacific. The first was characterized by eruptions of olivine-poor alkali basalt, followed by quiet effusion of soda rhyolite grading to pantellerite; this activity ended with formation of a collapse caldera. After a relatively long period of quiescence, rifting and downfaulting of the western side of the island was accompanied by violent explosions of soda rhyolite which built a large cone over the old caldera. The locus of eruptive activity moved outward and downward along tension fractures and old tectonic rifts. The eruptive history suggests that the underlying magma column became stratified toward the end of the activity.—D.B.V.

10799 **Bunce, Elizabeth T.** The Puerto Rico Trench, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 165-175, illus., 1966.

Results of recent geophysical investigations integrated with earlier data define the structure of the Puerto Rico trench. The floor is an elongate east-west, south-sloping abyssal plain, 8.3 km deep. Shallow sedimentary layers are uniform across the axis and thicken toward the west; deeper layers tilt and thicken to the south. A continuous reflection profile along the axis shows 1.5-2.0 km of sediments overlying the basement surface. The crustal structure section shows a difference between wave velocities of material under the trench and that under the outer ridge. The trench may be a downfaulted structure with activity continuing along the southern margin. That the trench is no older than Eocene is indicated by an acoustically transparent layer of Eocene rocks beneath the bottom reflection traceable down the north slope and beneath the upper abyssal plain sediments.—*from* Author's abstract

00727 **Bunch, T. E.; Cohen, Alvin J.; Dence, M. R.** Natural terrestrial maskelynite: Am. Mineralogist, v. 52, nos. 1-2, p. 244-253, illus., 1967.

Maskelynite occurs in the rocks of the central peaks of Clearwater West and Manicouagan craters, Quebec, Canada. Optical, X-ray and infrared absorption properties are similar to those of maskelynite in the Shergotty meteorite and in an artificially shocked gabbro. Heated maskelynite reverts to crystalline plagioclase, indicating only slight structural disordering unlike fused plagioclase glass. Experimental evidence suggesting that more than 50 kilobars shock pressure is required to form maskelynite, supports a meteorite impact origin for the craters.—Authors' abstract

**Bundy, F. P.** *See* Hanneman, R. E. 00769

**Burbank, W. S.** *See* Luedke, R. G. 10872

10853 **Burford, Robert O.** Strain analysis across the San Andreas fault and Coast Ranges of California, *in* Internat. symposium on recent crustal movement, 2d, Aulanko, Finland, 1965, Proc.: Acad. Sci. Fennicae Annales, ser. A–III, no. 90, p. 99–110, illus., 1966.

Horizontal components of surface distortion across the San Andreas fault and Coast Ranges have been derived by strain analysis. The strain pattern within the San Andreas fault zone shows predominant N–S contraction and E–W extension, which is consistent with right-lateral slip. Maximum contraction for Coast Range areas is generally oriented NE–SW at an angle of about 75° to the San Andreas fault, a trend essentially perpendicular to the axial traces of many Coast Range folds involving sediments as young as early Pleistocene. The overall strain pattern is dominated by crustal shortening transverse to the Coast Ranges with right-lateral simple shear superimposed in the vicinity of the San Andreas fault.—D.B.V.

10800 **Burk, C. A.** The Aleutian arc and Alaska Continental Margin, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–15, p. 206–214, illus., 1966.

The geologic history of the Alaskan Peninsula and Aleutian arc is different from that of Shumagin Shelf, which separates the two. The Shelf consists of Mesozoic turbidites, intruded by Tertiary ultramafics and overlain by Tertiary clastics. Volcanic-rich Tertiary rocks overlie thick deposits of Mesozoic clastics throughout the Peninsula and arc. Major uplifts followed intrusion of Jurassic batholiths and mid-Tertiary plutons in the Peninsula; uplift of the Shelf followed earliest Tertiary intrusion. The present Peninsula structure evolved during Pliocene. The Shelf is no older than mid-Tertiary. The Aleutian Trench is probably no older than Tertiary, the volcanic arc earliest Tertiary. Similarities between Shumagin Shelf and northern shelves of Bering Sea suggest similar histories and that the Aleutian arc was superimposed in earliest Tertiary.—B.S.H.

**Burkig, Valerie W.** *See* Greenman, Norman N. 00783

**Busch, Robert D.** *See* Lustig, Lawrence K. 00906

00838 **Byers, F. M., Jr.; Barnes, Harley.** Geologic map of the Paiute Ridge quadrangle, Nye and Lincoln Counties, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-577, scale 1:24,000, sections, 1967.

**Campbell, William J.** *See* Meier, Mark F. 10901

00651 **Canada Geological Survey.** Aeromagnetic map, Ford Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3550, scale 1:63,360, 1967.

00754 **Canada Geological Survey.** Aeromagnetic map, Duke River, Yukon Territory: Canada Geol. Survey Geophysics Paper 4299, scale 1:63,360, 1967.

00755 **Canada Geological Survey.** Aeromagnetic map, Kluane River, Yukon Territory: Canada Geol. Survey Geophysics Paper 4300, scale 1:63,360, 1967.

00756 **Canada Geological Survey.** Aeromagnetic map, Toshingermann Lakes, Yukon Territory: Canada Geol. Survey Geophysics Paper 4301, scale 1:63,360, 1967.

00757 **Canada Geological Survey.** Aeromagnetic map, Sheet 115 J/3, Yukon Territory: Canada Geol. Survey Geophysics Paper 4302, scale 1:63,360, 1967.

00758 **Canada Geological Survey.** Aeromagnetic map, Lynx City, Yukon Territory: Canada Geol. Survey Geophysics Paper 4303, scale 1:63,360, 1967.

00759 **Canada Geological Survey.** Aeromagnetic map, Doyle Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4304, scale 1:63,360, 1967.

00760 **Canada Geological Survey.** Aeromagnetic map, Coffee Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4305, scale 1:63,360, 1967.

00761 **Canada Geological Survey.** Aeromagnetic map, Thistle Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4306, scale 1:63,360, 1967.

00762 **Canada Geological Survey.** Aeromagnetic map, Stewart River, Yukon Territory: Canada Geol. Survey Geophysics Paper 4307, scale 1:63,360, 1967.

00763 **Canada Geological Survey.** Aeromagnetic map, Reindeer Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 4308, scale 1:63,360, 1967.

00764 **Canada Geological Survey.** Aeromagnetic map, Grand Forks, Yukon Territory: Canada Geol. Survey Geophysics Paper 4309, scale 1:63,360, 1967.

00765 **Canada Geological Survey.** Aeromagnetic map, Dawson, Yukon Territory: Canada Geol. Survey Geophysics Paper 4310, scale 1:63,360, 1967.

00766 **Canada Geological Survey.** Aeromagnetic map, Chandindu River, Yukon Territory: Canada Geol. Survey Geophysics Paper 4311, scale 1:63,360, 1967.

**Cannon, Julie R.** *See* Wanless, Harold R. 10722

00849 **Card, K. D.** (compiler). Sudbury mining area, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 405, scale 1 in. to 1 mi., 1967.

The map sheet includes a list of properties and mineral occurrences and production of Sudbury mining camp.—M.C.M.

00909 **Carlson, H. D.** (compiler). Chapleau–Foleyet sheet, Algoma, Cochrane and Sudbury Districts: Ontario Dept. Mines Map 2116, scale 1:253,440, 1967.

00902 **Carpenter, E. W.** Teleseismic signals calculated for underground, underwater, and atmospheric explosions: Geophysics, v. 32, no. 1, p. 17–32, illus., table, 1967.

The problem of estimating teleseismic signals from explosions in a representative range of environments is resolved into four component parts: the source function, elastic effects, nonelastic effects, and influence of the recording system. Source functions are derived appropriate to atmospheric, underwater, and underground explosions in a variety of rock types. The effects of elastic and nonelastic behavior are combined to define a standard propagation path. Signals are calculated from explosions of several different yields in the various mediums. It is shown that the relative seismic efficiency of explosions in different mediums is strongly dependent on yield.—D.B.V.

**Carron, M. K.** *See* Cuttitta, Frank. 00777

00862 **Carver, Robert E.** Distribution of hornblende in upper Coastal Plain sediments of Georgia [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 89, 1967.

**Castle, R. O.** *See* Yerkes, R. F. 00641

00880 **Catanzaro, E. J.** Triple-filament method for solid-sample lead isotope analysis: Jour. Geophys. Research, v. 72, no. 4, p. 1325–1327, table, 1967.

A triple-filament method for lead isotope analysis has been devised. The source consists of rhenium-ribbon sample filaments and a platinum-ribbon ionizing filament. Samples may be mounted as $PbCl_2$, $Pb(NO_3)_2$, or $Pb(OH)_2$; the latter appears to be best. Stable lead ion signals of $6\times10^{-11}$ amp are consistently obtained with 500-$\mu$g lead samples; 20-$\mu$g samples give stable signals of $4\times10^{-13}$ amp. The method does not have the ionization efficiency of the single-filament PbS or $PbC_2O_4$ method, but it has much greater precision. Ten analyses of a reference sample gave 95 percent confidence limits of Pb-204/Pb-206 = 0.054, Pb-207/Pb-206 = 0.023, and Pb-208/Pb-206 = 0.071 percent.—D.B.V.

00905 **Cederstrom, D. J.; Hodges, Arthur L., Jr.** Ground-water favorability of the Connecticut River basin, New England States: U.S. Geol. Survey Hydrol. Inv. Atlas HA-249, 2 sheets, scale 1:250,000, text, 1967.

With few exceptions, high-yield wells can be developed in the Connecticut River basin only from unconsolidated deposits. Areas where more than 0.5 mgd can be developed from wells contain aquifers of ice-contact and valley-train deposits; test drilling will be necessary to determine optimum thickness of section and location of coarsest sediments. In areas where yield would be less than 0.5 mgd, aquifers are similar except that they contain fine-grained sediments. Where aquifers are composed largely of glacial till and bedrock, potential yield is very small. Amount of water developed depends also upon amount of recharge to the aquifer in any area.—M.C.M.

00744 **Centini, Barry A.; Grant, Willard H.** A tourmaline-quartz dike near Decatur, DeKalb County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 87-88, 1967.

**Chamberlain, Theodore.** *See* Stearns, Harold. 10732

00788 **Chan, Frank L.** Spot test detection of sulfide in minerals: Anal. Chim. Acta, v. 37, no. 3, p. 391-393, table, 1967.

To determine if any differences exist in the behavior of different sulfide minerals, nine old and new methods of spot detection were examined. The results show some interesting differences between the tests, which can be utilized for the characterization of sulfide minerals. For instance molybdenite gives a negative response to the iodine-azide reaction in contrast to other sulfides; cinnabar on heating with ammonium chloride sublimes along with it. Most outstanding phenomena concern the behavior of marcasite, pyrrhotite and pyrite; their chemical composition is the same, but they differ in reactions with benzoin and mercury cyanide. Of special interest is the difference between arsenopyrite and orpiment. The methods described here could probably be used not only for natural sulfides but also for synthetic ones.—G.D.C.

10735 **Chapman, Rodger H.** The gravity field in northern California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 395-405, illus., 1966.

The author presents a resumé of gravity survey coverage of northern California, and summarizes the general features of the gravity field for several areas, including the Coast Range province and offshore areas, the Great Valley province, the Sierra Nevada and Great Basin provinces, the Cascade Mountains and Modoc Plateau provinces, and the Klamath Mountains province. The need for additional gravity survey data in areas not now adequately covered is emphasized.—M.S.T.

10782 **Chelini, J. M.** Some high-purity quartz deposits in Montana: Montana Bur. Mines and Geology Bull. 54, 43 p., illus., tables, 1966.

The bulletin includes only known or reported high-purity deposits, chiefly of magmatic origin. Principal uses for the silica are as abrasives, refractories, metallurgical materials, and glass. Descripitions of 16 deposits are given with geologic sketch maps and analyses. All but five are quartz-core pegmatites; one is sedimentary, and the others are quartz dikes.—E.S.L.

10783 **Chelini, J. M.; Smith, R. I.; Jones, F. P.** Progress report on clays and shales of Montana, 1964-1965: Montana Bur. Mines and Geology Bull. 55, 38 p., illus., tables, 1966.

This report, fifth in a series of progress reports on a survey designed to catalog the clay and shale deposits of the state and to determine possible uses, if any, of the raw materials sampled, contains a description of 77 samples. The clays are tested for use as ceramic raw materials, as possible sources of expanded shale (lightweight aggregate for concrete), and as possible sources of alumina for the production of metallic aluminum.—Authors' abstract

00803 **Cherry, J. T.** Computer calculations of explosion-produced craters: Internat. Jour. Rock Mechanics and Mining Sci., v. 4, no. 1, p. 1-22, illus., 1967.

A technique is described for calculating mound and cavity growth during nuclear and high-explosive cratering events that features a standard, numerical approach to high-intensity, stress-wave propagation coupled with a unique model of material behavior in brittle failure. Density and elastic velocity of rocks were determined *in situ* from logging tests during a preshot testing program; hydrostatic compressibility, triaxial data, tensile strength, Hugoniot elastic limit, and high pressure Hugoniot data were determined by laboratory tests on rock samples. Calculations are given for Projects Hardhat, Danny Boy, Sulky, and three parameter studies of rhyolite equations-of-state. Danny Boy data confirmed spalling as the dominant nuclear cratering mechanism in hard, dry rock. Rhyolite parameter studies emphasized the importance of medium properties in determining crater geometry.—V.S.N.

10776 **Chouhan, R. K. S.** Aftershock sequence of Alaskan earthquake of 28th March 1964: Pure and Appl. Geophysics, v. 63, p. 43–48, illus., tables, 1966.

The aftershock sequence of the Alaskan earthquake has been studied in the light of Benioff's creep theory of aftershocks. The recovery consists of two linear segments of compressional elastic creep type and the duration of activity is about 24 days. The ratio of the total elastic strain rebound increments of aftershocks to the principal shock was 0.24 and their proportion of energy released as seismic waves was 0.004. Thus two percent of the strain energy stored in the creep elastic element was released in seismic waves and the rest lost as heat. In dual type recovery (compression plus shear) 6–8 percent of the total energy is used as seismic waves. Hence the major portion of the seismic wave energy was due to shear-type recovery.—D.B.V.

10784 **Chow, Tsaihwa J.; Patterson, C. C.** Concentration profiles of barium and lead in Atlantic waters off Bermuda: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 397–400, illus., table, 1966.

Profiles of barium and lead concentration were obtained for the Atlantic waters off Bermuda and compared with those of the Pacific and of the Pacific and Mediterranean, respectively. The purpose was to determine the extent of industrial contamination of the water. From this study, the concentration of lead in surface waters of about 0.2 $\mu$/kg for the Northern Hemisphere, previously estimated by Tatsumoto and Patterson (1963) is revised downward to 0.07 $\mu$g/kg; it is suggested that pre-industrial lead concentrations in surface waters was about 0.01–0.02 $\mu$g/kg.—V.S.N.

10753 **Christensen, Mark N.** Quaternary of the California Coast Ranges, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 305–314, illus., tables, 1966.

The principal elements of the Quaternary history of the Coast Ranges north and south of San Francisco are found in sedimentary strata, marine terraces, and drainage anomalies. The history of the southern ranges is documented by rather extensive sedimentary deposits of Pliocene and Pleistocene age. In the northern ranges, the stratigraphic record is less complete, but anomalous drainage patterns are more conspicuous. Glacial effects are recorded only on a few isolated peaks in the northern Coast Ranges.—Author's introduction

00720 **Chromy, Ben.** Unusual quartz crystals from Herkimer County, New York: Earth Sci., v. 20, no. 2, p. 58–62, illus., 1967.

A quartz crystal with rare habit from the Middleville area, New York, is described and compared to similar crystals in Dana's *System of Mineralogy* (1892) and Beck's *Mineralogy of New York* (1842).—B.S.H.

**Clark, A. M.** *See* Halls, C. 00928

10890 **Clark, G. B.** Deformation moduli of rocks, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 133–172, illus., tables; reply to discussion by D. V. Deere and A. J. Hendron, Jr., p. 174, 1966.

There is a real need for more precise definitions of physical properties of rocks, particularly the deformation moduli of both laboratory specimens and rock masses *in situ*. A vital initial step in establishing standards is to recognize existing problems of engineering applications. One of the prime purposes of this paper is to furnish background information on deformation moduli so that further steps in setting up standards can be taken. More basic and applied research will be required before satisfactory standards can be established.—Author's abstract

**Clark, Lorin D.** *See* Peck, Dallas L. 10747

00846 **Clark, R. C., Jr.; Blumer, M.** Distribution of *n*-paraffins in marine organisms and sediment: Limnology and Oceanography, v. 12, no. 1, p. 79–87, illus., table, 1967.

Benthic algae from the New England coast, laboratory-grown planktonic algae, a pelagic alga, a sample of mixed phyto- and zooplankton, and a recent marine sediment were analyzed for their normal paraffin distribution. Normal paraffins occurred in all samples. Benthic and planktonic algae and the mixed plankton exhibited only a slight odd-carbon predominance. In all hydrocarbon features the algae and the plankton differed from recent marine sediments, suggesting that the normal paraffins of recent marine sediments are largely derived from sources other than the organisms studied. Differences in the hydrocarbon distribution patterns of various classes of benthic algae may be of taxonomic value. Pristane occurs in several benthic and planktonic algae; phytane, if present, was at a concentration too low to be detected.—G.D.C.

**Clark, R. S.** *See* Kuroda, P. K. 00681

10772 **Clark, William B.** Economic mineral deposits of the Sierra Nevada, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 209–214, illus., 1966.

The Sierra Nevada province is the source of large quantities of sand, gravel, crushed and broken stone, tungsten, limestone and its products, asbestos, barite, dimension stone, mineral filler, rhyolitic ash, soapstone, and uranium. Smaller amounts of gold, silver, copper, zinc, molybdenum, silica, gem and ornamental minerals, and wollastonite are also recovered. The output of gold, once the principal commodity, has decreased greatly in recent years. Also found, though little exploited, are deposits of arsenic, antimony, andalusite, clay, garnet, cobalt, lead, nickel, platinum, feldspar, pyrite, manganese, mercury, quartz crystals, tellurium, thorium, and zirconium. Much of the mineral wealth is in the western foothills, especially in the central and northern portions of the range.—M.S.T.

**Clarke, R. S., Jr.** *See* Cuttitta, Frank. 00777

**Coates, D. F.** *See* Sassa, K. 00805

**Coates, D. F.** *See* Paulding, B. W., Jr. 10828

10840 **Coates, D. F.; Gyenge, M.** Plate-load testing on rock for deformation and strength properties, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 19–35, illus., tables; reply to discussion by B. Ladanyi and D. Nguyen, p. 40, 1966.

Plate-load tests conducted underground to determine *in situ* strength and deformation properties provide information on rock mass properties as opposed to strength of rock substance. A plate placed on the surface of the material deflects as contact pressure is increased, and deformation and shear failure ultimately occur. Results of tests conducted on iron ore, paint rock, and ash rock are compared with results of laboratory tests and of analyzing failures of the rock mass; moderately good agreement was obtained. Dispersion of strength values must be expected in testing geological materials. Suggested specifications are given for plate-load, conventional uniaxial compression, and classification uniaxial compression testing.—*from* Authors' abstract

00683 **Cobb, James C.** A trace-element study of iron meteorites: Jour. Geophys. Research, v. 72, no. 4, p. 1329–1341, illus., tables, 1967.

Concentrations of Co, Cu, As, Ga, Ir, and Au in 33 iron meteorites have been measured; on the basis of these and published data the irons are grouped according to similarities in trace-element content. At least three melts varying chiefly in Ni and Ga are required to account for the compositions of all the iron meteorites.—D.B.V.

**Cohen, Alvin J.** *See* Bunch, T. E. 00727

10702 **Cohen, T. J.; Meyer, R. P.** The Midcontinent Gravity High—Gross crustal structure, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 141–165, illus., tables, 1966.

Two reconnaissance seismic profiles were recorded on the Minnesota-Wisconsin portion of the Midcontinent Gravity High in 1963 and 1964. Crustal thickness profiles and a contour map on the M-discontinuity show results of the study. The discontinuity was found to be about 46-km deep under the gravity high and 42-km deep under the low, and its regional structure in the broad vicinity of the high is in reasonable accord with regional compensation predicted theoretically. The mantle's apparent velocity is normal and that of the major crustal layer about 6.5–6.6 kmps. The existence of a thick sedimentary sequence associated with the gravity low is confirmed. A strong negative correlation was found between Bouguer anomalies and seismic time terms from the major crustal layer in the eastern flanking low. It was inferred that the density of sediments filling the trough increases with depth.—E.S.L.

00712 **Cole, J. Glenn.** Regional stratigraphy of the Marmaton Group of northeastern Oklahoma: Shale Shaker, v. 17, no. 5, p. 86–97, illus., table, 1967.

The feasibility of tracing lithostratigraphic units, as defined by surface units, into the subsurface to ascertain their geographic distribution and lateral variations has been demonstrated by a study of the Marmaton Group (Pennsylvanian) of northeastern Oklahoma. A complex system of differing environments which existed simultaneously and also shifted laterally with time is represented. Limestones thin and pinch out in a southerly direction and thicken to the north; lateral variations in thickness are believed to represent extensive marine banks. Clastic units present a complex pattern of thickening to the northeast and southeast with an increase in coarse material indicating several source areas. Continuous deposition between the Marmaton Group and the overlying Skiatook Group is suggested; channeling present is probably due to increased influx of coarser clastics with accompanying scour and fill.—B.S.H.

00700 **Colinvaux, Paul A.** Bering land bridge—Evidence of spruce in Late-Wisconsin time: Science, v. 156, no. 3773, p. 380–383, illus., tables, 1967.

A 14-meter core from a crater lake on Saint Paul Island in the Pribilofs has been examined by pollen analysis. Radiocarbon dating indicates that the core spans more than 10,000 years and probably more than 18,000 years. A spruce-pollen maximum about 10,000 years ago suggests that spruce advanced to the flanks of the southern coast of the Bering land bridge toward the close of the land-bridge period. The forests of Alaska and Siberia did not merge, however, and the environment of the southern coast of the land bridge remained cold.—Author's abstract

10900 **Colwell, Robert L.** Uses and limitations of multispectral remote sensing, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 71–100, illus., tables, 1966.

Some proponents of multispectral remote sensing herald it as the means by which data-gathering problems, both terrestrial and extra-terrestrial, can best be solved. Others assert that little or no information of vital importance has found to be better derivable through multispectral remote sensing than through less sophisticated

means, and consequently the continuation of a vigorous research and development program is unwarranted. Both groups need to examine the uses and limitations of multispectral remote sensing. This paper undertakes an examination through use of specific examples and analytical discussions of various factors governing remote sensing. It is hoped that this approach will place in better focus enthusiastic claims and pessimistic criticisms, thereby assisting the reader in formulating his own opinion relative to the potential usefulness of multispectral remote sensing.—*from* Author's abstract

10751 **Compton, Robert R.** Granitic and metamorphic rocks of the Salinian block, California Coast Ranges, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 277–287, illus., tables, 1966.

The Salinian block is an elongated segment of the Coast Ranges, characterized by a basement of granitic and high-grade metamorphic rocks. This survey of the principal basement exposures shows a complex but reasonably consistent plutonic history. The metamorphic rocks apparently represent one heterogeneous sedimentary assemblage of Paleozoic or Mesozoic age. Their platform-type sandstones and limestones and dolomitic rocks prove they are not metamorphosed Franciscan rocks. All were folded and metamorphosed more than once. Plutonic rocks ranging from peridotite to potassic granite were emplaced before or during the first folding as well as later.—M.S.T.

00631 **Conolly, J. R.; Needham, H. D.; Heezen, Bruce C.** Late Pleistocene and Holocene sedimentation in the Laurentian channel: Jour. Geology, v. 75, no. 2, p. 131–147, illus., tables, 1967.

Stratigraphic units in channel-bottom deposits as much as 40 feet thick include—below gray sediments at the surface—brown silty clay, reddish-brown glaciomarine deposits, and reddish-brown bedded sediments. Detailed petrologic studies of cores suggest that the brown units are Pleistocene and, in part, correlatable with recognized terrestrial events. Their color is due to detritus from red Carboniferous–Triassic rocks. The gray unit probably is largely postglacial river sediment derived from Precambrian crystalline rocks.—D.R.M.

10895 **Conway, William; Yarbrough, Lavern A.** Characteristics and uses of an L-band radiometer, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 467–473, illus., 1966.

The UHF radiometer offers good possibilities for development of a tool that may be used to evaluate materials in geological exploration. The L-1000 instrument, described in this paper, produced stable operation and by relating the signal levels at its output to characteristics of the materials tested, it can be used in geological surveys. Moisture has its effects but it can be dealt with once materials are tested sufficiently to place them in classes and the upper and lower limits of the variations have been established. The emissivity of the material is the primary factor that determines the signal level for a given temperature. This can be used to advantage by relating the output of the UHF radiometer to the dielectric constant of the material which may be used to classify or identify the material.—*from* Authors' summary

10741 **Cotton, C. A.** The continental shelf: New Zealand Jour. Geology and Geophysics, v. 9, nos. 1–2, p. 105–110, illus., 1966.

Explorations of the structure of the piles of sediment underlying parts of the continental shelf have confirmed the theory that in general this ubiquitous feature has been formed by up- and out-growth due to deposition on the shelf (as topset beds) and on the continental slope (as foreset beds) during a prolonged movement of either continuous or intermittent submergence. Examples from off Norfolk, Va., and Newport, R. I., and the west coast of Mexico are cited in illustration.—D.B.V.

**Couch, R. W.** *See* Dehlinger, Peter. 00868

00696 **Crandell, Dwight R.; Mullineaux, Donal R.** Volcanic hazards at Mount Rainier, Washington: U.S. Geol. Survey Bull. 1238, 26 p., illus., tables, 1967.

The extent, frequency, and apparent origin of events that have occurred at Mount Rainier volcano over the past 9,000 years are examined to evaluate the effects on man of similar events in the future. The volcano is characterized by long quiet periods alternating with brief episodes of activity, and its present dormant state is not a sign that the volcano is extinct; a substantial steam, pumice, or lava eruption might occur once each 500 to 1,000 years. The greatest danger from such eruptions would be related devastating floods and debris flows, particularly the latter since their movement is concentrated along valley floors where works of man are found. Careful land use planning should be put into effect to minimize these dangers. Tables list postglacial eruptions, debris flows, and avalanches, and also the effects and possible warning signs of impending activity and possible frequency.—V.S.N.

00785 **Craven, John P.** Working in the sea, *in* The ocean's resources: Internat. Sci. and Technology, no. 64, p. 50–57, illus., 1967.

If man is to make a serious effort to exploit the resources of the ocean, he must be able to work there extensively and continuously. Violent forces encountered at the ocean's surface under storm conditions have not been dealt with successfully; it will be a long time before ocean technology can guarantee the safety of people who occupy structures there. The ocean depths are more consistently peaceful, although bottom currents, cold, and pressure pose serious control problems in underwater vehicles, and perhaps foundation problems also.—G.D.C.

00859 **Creasey, S. C.** General geology of the Mammoth quadrangle, Pinal County, Arizona: U.S. Geol. Survey Bull. 1218, 94 p., illus., geol. maps, 1967.

Bedrock is largely limited to the western third of the Mammoth quadrangle; locally valley fill extends across the entire area. Bedrock ranges in age from Precambrian to Pleistocene and includes intrusive, extrusive, and sedimentary rocks. Post–Early Cretaceous and pre–Pliocene deformation, chiefly faulting, produced the major structures; the dominant fault is the Mogul, a right-lateral normal fault. The map area contains prominent deposits of copper, lead, zinc, molybdenum, vanadium, tungsten, gold, and silver.—*from* Author's abstract

10844 **Cressey, George B.** Land forms, Chap. 1 *in* Geography of New York State (edited by J. H. Thompson): Syracuse, N. Y., Syracuse Univ. Press, p. 19–53, illus., tables, 1966.

A brief review of the geologic past is given, including the glacial story, and preglacial history. The landform regions identified and described include the Adirondack and edge of New England uplands; St. Lawrence–Champlain, Hudson–Mohawk, Erie–Ontario, and Triassic lowlands; the Appalachian upland with Finger Lakes hills and Catskill Mts.; and the Atlantic Coastal lowland on Long Island and Staten Island. Special features, such as lakes, gorges, falls, beaches and moraines are summarized. The mineral spa of Saratoga Springs is also mentioned.—G.D.C.

00861 **Crickmay, C. H.** The method of indivisible aggregates in studies of the Devonian: Calgary, Alberta, E. de Mille Books (published by author), 22 p., illus., 1967.

Doubting the possibility of unbroken sequences of deposition in which the entire Devonian thickness might be 114 miles, a promising method of working toward a true chronological sequence among depositional events might consist in carrying analysis of fossil or microfacies evidence from a number of localities down to the indivisible aggregate, and then bringing local evidence together without violating superposition. In practice the procedure is abandoned because of the tendency to lump unrelated aggregates. Correlation of the Devonian in western Canadian exploration is hindered by wide departure in the use of formation names, particularly the name Slave Point. Fossil assemblages and lithologic aggregates of this and other attempted correlations are listed, and some diagnostic brachiopod species are illustrated.—G.D.C.

00866 **Crittenden, Max D., Jr.; Wallace, Chester A.; Sheridan, M. J.** Mineral resources of the High Uintas primitive area, Utah: U.S. Geol. Survey Bull. 1230-I, p. I1-127, illus., table, geol. map, 1967.

Bedrock within the High Uintas primitive area consists entirely of sedimentary rocks assigned to the Uinta Mountain Group (younger Precambrian); these rocks, mainly quartzite and arkose but including some shale, show little evidence of regional metamorphism. The area lies astride the crest of the Uinta Mts., structurally an elongate east-trending fold bordered on its north and south flanks by nearly vertical faults. None of the small faults contain mineral deposits or show any evidence of the passage of mineralizing solutions. Aeromagnetic and gravity studies give no indication of mineralized areas. No mines or mineral deposits in the area are known, and no mineral potential is indicated. —*from* Authors' abstract

00804 **Crouch, S. L.; Fairhurst, C.** A four-component borehole deformation gauge for the determination of *in situ* stresses in rock masses: Internat. Jour. Rock Mechanics and Mining Sci., v. 4, no. 2, p. 209-217, illus., 1967.

A four-component borehole deformation gage, built to investigate high lateral stress in certain granite quarries in central Minnesota, is essentially a more sophisticated version of the single-component gage, and also contains a built-in check not available on other multi-component gages. A description of the gage is given, and the results of some stress determinations made on a granite quarry floor are presented. Additions necessary to make the gage suitable for determining the complete state of stress from a single borehole are indicated. —*from* Authors' abstract

10842 **Crowell, John C.** Displacements along the San Andreas fault, California, *in* Internat. symposium on recent crustal movement, 2d, Aulanko, Finland, 1965, Proc.: Acad. Sci. Fennicae Annales, ser. A-III, no. 90, p. 119-125, illus., 1966.

Geologic terranes along the San Andreas fault system have been intermittently offset with predominant right slip since early Tertiary time at least. Displacements of progressively older rocks (from Pleistocene up to 16 km to lower Miocene up to 300 km) are well established; possible older and greater displacements up to 500 km are not as certain. The history of movement can be extended back into the immediate geologic past on the basis of studies of Pleistocene and Recent landforms and associated deposits. Understanding of Recent movements can therefore be based on a greater time interval, and perhaps extrapolated into the future with more confidence. Parts of some faults are relatively active, others are relatively quiescent.—D.B.V.

10756 **Curray, Joseph R.** Geologic structure on the continental margin, from subbottom profiles, northern and central California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 337-342, illus., 1966.

This is a reconnaissance study based mainly on continuous acoustic reflection profiles, supplemented by considerations of bathymetry, and a few samples of rock from the sea floor. The author concludes that: the gross structure underlying the continental shield and slope is dominated by a ridge of basement rock, which is at least partly Cretaceous granite and localized deposition during the Tertiary; Tertiary and Quaternary sediments underlying the steeper parts of the slope, mostly on the seaward flank of the ridge, have locally slumped to form great slide masses; the San Andreas fault zone curves eastward from Point Arena to follow the shelf to near Shelter Cove; and many other faults on the shelf are probably connected to faults mapped on land.—M.S.T.

00777 **Cuttitta, Frank; Clarke, R. S., Jr.; Carron, M. K.; Annell, S. S.** Martha's Vineyard and selected Georgia tektites—New chemical data: Jour. Geophys. Research, v. 72, no. 4, p. 1343-1349, illus., tables, 1967.

Results are presented of chemical analyses of the Martha's Vineyard and seven Georgia tektites. Continuity of the compositional variations of all North American tektites, their general geographic associations, and identical K-Ar ages of 34±1 m.y. strongly suggest that the Georgia and Martha's Vineyard tektites represent the high-silica end-members of the continuous range of variations exhibited by the North

American tektites, and that the Texas, Georgia, and Martha's Vineyard tektites have a common origin. They could have formed by fusion and differential volatilization upon meteor impact on an area of siliceous igneous rocks.—D.B.V.

10687 **Dainty, A. M.; Keen, C. E.; Keen, M. J.; Blanchard, J. E.** Review of geophysical evidence on crust and upper-mantle structure on the eastern seaboard of Canada, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 349–369, illus., tables, 1966.

Evidence shows that crustal structure is complicated, and the deeper structure seems to be related to surface geology. Crustal thickness varies from 15 km beneath the continental slope off Sable Island, to 30–35 km under the Nova Scotian shelf, and 40–45 km under the Gulf of St. Lawrence Carboniferous basin. Associated with increase in thickness is an intermediate layer within the crust, velocity 7 kmps. In the upper mantle beneath the ocean basin, shelf, and western Appalachians, velocities are about 8 kmps, but near 8.4–8.7 under the Gulf and northeast Newfoundland. Interpretation of gravity observations has been controlled by seismic results. One interpretation, suggesting that mantle density below 45 km beneath the continent is higher than that beneath the ocean basin, agrees with velocities found beneath thicker parts of the crust.—*from* Authors' abstract

00782 **Dalquest, Walter W.** Mammals of the Pleistocene Slaton local fauna of Texas: Southwestern Naturalist, v. 12, no. 1, p. 1–30, illus., tables, 1967.

Reinvestigation, including washing of matrix, in the old Slaton quarry, Lubbock County, Texas, yielded remains of 30 kinds of mammals. A white-tailed prairie dog, *Cynomys vetus*, is reported from Texas for the first time. Numerous good specimens of the extinct water rat, *Neofiber leonardi*, show the distinctness of that species. Abundant material permits detailed description of two extinct species of horses. The vertebrate fauna indicates a mild climate with extensive grasslands and scattered trees and thickets in the vicinity of the fossil site. The fauna is probably of early Illinoian age.—Author's abstract

**Damon, Paul E.** *See* Livingston, Donald E. 00680

**Dass, A. S.** *See* Boyle, R. W. 00797

00939 **Davies, J. C.; Pryslak, A. P.** (compilers). Lac Seul sheet, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 407, scale 1 in. to 2 mi., 1967.

00940 **Davies, J. C.; Pryslak, A. P.** (compilers). Trout Lake–Birch Lake sheet, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 406, scale 1 in. to 2 mi., 1967.

00941 **Davies, J. C.** French Narrows area, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 401, scale 1 in. to 1/4 mi., text, 1967.

Oldest rocks in the French Narrows area are massive and pillowed mafic metavolcanics, probably mostly basalt; within the central basaltic area are a number of elongate bodies of gabbro which appear to be concordant with surrounding rocks. An anticlinal axis lies within the area of south-dipping basalts and in the central map-area it may coincide with a fault zone that was not defined. Mineralization appears to be most abundant in the main basalt area south of the largest gabbroic body.—M.C.M.

10754 **Davis, Fenelon F.** Economic mineral deposits in the Coast Ranges, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 315–321, illus., tables, 1966.

Petroleum is the principal commodity of the Coast Ranges, with cement, sand, gravel, mercury, natural gas, rock products and salt accounting for significant production. It is estimated that the total cumulative value of all mineral commodities during the period 1850–1965 is 2,500,000,000 dollars.—M.S.T.

10738 **Davis, Gregory A.** Metamorphic and granitic history of the Klamath Mountains, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 39–50, illus., 1966.

Metamorphic relations within the Klamath Mts. and its subprovinces are complex, although two distinct periods of regional metamorphism can be recognized—late Paleozoic and Jurassic. Where three of the four subprovinces are tectonically superposed, the structural and metamorphic sequence, bottom to top is: western Paleozoic and Triassic subprovince (lower greenschist facies), central metamorphic subprovince (upper greenschists and almandine-amphibolite facies), and eastern Paleozoic subprovince (lower greenschist facies). Serpentinized peridotites of the sill-like Trinity ultramafic pluton separate the eastern Paleozoic subprovince from the underlying central metamorphic subprovince in this area. Granitic intrusions—typically dioritic, quartz-dioritic, or granodioritic—are present throughout the province, but are concentrated within a central zone which excludes most of the western Jurassic and eastern Paleozoic subprovinces.—M.S.T.

10745 **Davis, S. N.** Hydrogeology field trip—East Bay area and northern Santa Clara Valley, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 465–471, illus., 1966.

The purpose of this field trip road log is to obtain a brief understanding of the ground-water geology of the area adjacent to the southern part of San Francisco Bay. Although the area is fairly restricted in geographic extent, it presents a wide variety of problems. Some of these are declining ground-water levels, land subsidence, sea-water intrusion, correlation of aquifers and aquicludes, location and design of recharge basins, and the barrier effects of active faults. The trip starts at the Oakland Bay Bridge, goes north to Richmond, and back south as far as the Guadalupe–Los Alamitos recharge basins.—M.S.T.

10866 **Decker, R. W.; Hill, D. P.; Wright, T. L.** Deformation measurements on Kilauea Volcano, Hawaii: Bull. Volcanol., v. 29, p. 721–731, illus., 1966.

Repeated electronic distance measurements across Kilauea Caldera show definite horizontal expansion related to vertical uplift and outward tilting of the summit prior to an eruption, and contraction during and after a flank eruption. Changes in distance across the caldera can be measured to accuracies of 4–7 ppm. On active volcanos where ground surface deformation exceeds 10–100 ppm with changes in subsurface magma pressure or volume, repeated horizontal distance measurements can be a most useful technique.—D.B.V.

10905 **Deere, D. U.; Hendron, A. J., Jr.** Discussion [of "Deformation moduli of rocks," by G. B. Clark, 1966], *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 173–174, illus., 1966.

This is a discussion of the procedures necessary and the amount of specimen needed to achieve valid results for accurate calculation of deformation moduli for *in situ* tests. (See Clark, ibid., p. 133–172.)—M.S.T.

00868 **Dehlinger, Peter; Couch, R. W.; Gemperle, Michael.** Gravity and structure of the eastern part of the Mendocino escarpment: Jour. Geophys. Research, v. 72, no. 4, p. 1233–1247, illus., 1967.

Results of a surface-ship gravity survey over the eastern part of the Mendocino escarpment are presented. East of about 130° W. the Mendocino escarpment is an escarpment in the M-discontinuity, apparently a result of juxtaposition of two different density mantles, the entire region being essentially in isostatic equilibrium. West of 130° W. the escarpment is relatively small and mantle densities on both sides appear to be nearly the same. The significance of the gravity data is considered in terms of previous interpretations of the region.—D.B.V.

10823 **Deklotz, E. J.; Brown, J. W.; Stemler, O. A.** Anisotropy of a schistose gneiss [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st.

Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 465–470, illus., table, 1966.

The testing program reported in this paper concerns the anisotropic studies of a schistose gneiss. Tests were made on specimens oriented in three mutually perpendicular directions, two of which were in the plane of the schistosity. In addition, tests were made on specimens oriented at 30° to the schistosity. Tests performed include direct tension and unconfined and triaxial compression. Triaxial testing was done at confining pressures of 1,000, 3,000, and 10,000 psi. A discussion of equipment used, methods of test, analysis of data, and interpretation of results is included. Results of the testing program show that strength and axial strain to failure are directionally dependent. Shear strength differences as high as 50 percent and strain differences as high as 195 percent were observed.—*from* Authors' summary

**Deklotz, E. J.** *See* Barry, A. J. 10899

**DeLaney, A. Otis.** *See* Englund, Kenneth J. 00650

10849 **deLaubenfels, David J.** Soil, Chap. 5 *in* Geography of New York State (edited by J. H. Thompson): Syracuse, N. Y., Syracuse Univ. Press, p. 104–110, illus., 1966.

The soils are divided into six regions on the basis of associated types related to origin and underlying terrain: (1) limy soils on glacial till over undulating to rolling terrain; (2) limy soils on glacial lake sediments over level to undulating terrain; (3) alluvial soils in valley bottoms; (4) deep acid soils on glacial terrain over hilly terrain; (5) shallow acid soils on glacial till over steep terrain; and (6) coarse-textured soils on sands and gravels.—G.D.C.

00779 **DeLise, K. C.** Biostratigraphy of the San Emigdio Formation, Kern County, California: California Univ. Pubs. Geol. Sci., v. 68, 83 p., illus., tables, 1967.

A continuous sequence of marine upper Eocene and Oligocene strata consisting of the Tejon, San Emigdio, Pleito, and Vaqueros Formations is exposed in San Emigdio Canyon. The Tejon and lower 660 feet of the San Emigdio Formation yielded 126 species and varieties of Foraminifera (Narizian Stage, upper Eocene). The upper 430 feet of the San Emigdio contains a molluscan fauna of 39 species and varieties. The foraminiferal assemblages indicate a bathyal environment during deposition of the Tejon. Foraminifera and Mollusca from the middle San Emigdio indicate a neritic environment. The molluscan fauna from the upper San Emigdio indicates further shallowing to upper neritic and littoral depths. Comparable shallow depths persisted, at least locally, for the Pleito and Vaqueros.—D.C.R.

10796 **Demenitskaya, R. M.; Dibner, V. D.** Morphological structure and the Earth's crust of the North Atlantic region, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 63–79, illus., 1966.

The Norway–Greenland basin differs from the Atlantic by having lesser depths, greater crustal thicknesses, and a more complex transitional type crustal structure. The abyssal area is bordered and crossed by huge neotectonic scarps and dominated by a rift zone, continuous with the mid-Atlantic rift and marked by modern volcanism and seismic activity. Metamorphosed Caledonian(?) rocks in the rift form the basement of the associated volcanoria. The abyssal area is underlain by oceanic crust in which there is a clear absence of the disconformity between the 8.1 kmps and 7.5 kmps mantle. Continental shelves consist of folded Caledonian rocks overlain by sediments and plateau basalt, and crossed by large faults. The term avant shelf is proposed to distinguish a special shelf which originated partly by faulting. A northwest-trending world-wide lineament extending from Baffin Bay to the mid-Indian ridge is postulated.—B.S.H.

**Dence, M. R.** *See* Bunch, T. E. 00727

**DeNoyer, John M.** *See* Willis, David E. 10692

10694 **DeNoyer, John M.; Frantti, G. E.; Willis, David E.** Short note on underwater sound measurements from the Lake Superior experiment, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 241–248, illus., 1966.

Underwater sound recordings of the Lake Superior shots showed that the predominant energy was contained in a band between 60 and 250 cps. Late arrivals were found that correlate with reflections from the main shoreline, numerous islands, and a few prominent shoals. By recording on magnetic tape and by using various passband filters on the laboratory playback, it was found that more precise times could be determined for the water wave arrivals.—Authors' abstract

00691 **Denton, George H.; Stuiver, Minze.** Late Pleistocene glacial stratigraphy and chronology, northwestern St. Elias Mountains, Yukon Territory, Canada: Geol. Soc. America Bull., v. 78, no. 4, p. 485–510, illus., table, geol. map, 1967.

Four periods of glaciation separated by three nonglacial intervals all of late Pleistocene age are indicated in the northeastern St. Elias Mts. by overlapping drift sheets and their characteristic weathered zones. Twenty C-14 dates give a chronology of events and show the oldest glacial interval began well before 49,000 B.P. and latest, neoglaciation, began about 2,640 B.P. Comparison of this chronology with that of other similar events in widely separated places in North America shows that their climatic fluctuations are broadly synchronous.—A.B.G.

00648 **Detterman, Robert L.; Hartsock, John K.** Geology of the Iniskin–Tuxedni region, Alaska: U.S. Geol. Survey Prof. Paper 512, 78 p., illus., tables, geol. map, 1966 [1967].

About 26,000 feet of Lower, Middle, and Upper Jurassic rocks are exposed in the Iniskin–Tuxedni region, Cook Inlet, Alaska. The Lower Jurassic is mainly lava flows and volcaniclastic rocks. Epieugeosynclinal sedimentary rocks of the graywacke, sandstone, conglomerate, siltstone, and shale facies were deposited during the Middle and Late Jurassic time; these rocks are abundantly fossiliferous. The Jurassic sequence rests on metamorphosed Triassic basement, and both the Triassic and Lower Jurassic were intruded by the Aleutian Range batholith. Tertiary conglomerate overlies the Jurassic in part of the area. The region is cut by the Bruin Bay fault, and Iliamna Volcano lies near this major lineament. Oil and gas seepages are present and several wells were drilled on Fitz Creek anticline.—R.L.D.

10758 **Dibblee, T. W., Jr.** Evidence for cumulative offset on the San Andreas fault in central and northern California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 375–384, illus., 1966.

The author presents evidence that the San Andreas fault is a generally vertical plane of right-lateral shear movement active during most, or all of the Cenozoic, with very large cumulative offset or displacement. This is suggested not only by displacements of geologic units, but also by structural patterns associated with the fault. This pattern is expressed in the severely folded condition of the bordering Cretaceous and Cenozoic formations in which axes of folds on both sides trend slightly more east–west than the fault. As the folds approach the fault, they become more compressed and axes veer more nearly parallel to it. This persistent pattern all along the fault is no doubt the effect of right-lateral drag on the fault combined with pressure of one block against the other.—Author's summary

10813 **Dibblee, T. W., Jr.** Geology of the central Santa Ynez Mountains, Santa Barbara County, California: California Div. Mines and Geology Bull. 186, 99 p., illus., tables, geol. maps, 1966.

The area includes the east-trending Santa Ynez Range, the coastal strip to the south near Santa Barbara, and parts of the Santa Ynez River area and northwest-trending San Rafael Mts. to the north. Stratigraphic units from oldest to youngest are: the Franciscan Formation, a very thick sequence of Cretaceous shales and sandstone,

and Tertiary marine and terrestrial strata with lower Miocene on the Range and younger marine formations on both sides where Pleistocene fanglomerates and alluvium mantle the eroded surface of all older formations. Parts of three major structural blocks are separated by the Santa Ynez and Little Pine reverse faults, active during Quaternary time. Between the Santa Ynez Mts. block and the folded San Rafael Mts. block is a synclinal wedge increasingly compressed southeastward. Chief mineral resources are oil and gas, and small deposits of quicksilver.—G.D.C.

**Dibner, V. D.** *See* Demenitskaya, R. M. 10796

10752 **Dickert, Paul F.** Tertiary phosphatic facies of the Coast Ranges, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 289–304, illus., tables, 1966.

Phosphatic facies are thickest and richest in southern and central California. Phosphatic rocks diminish in thickness and content from the Ventura and Los Angeles basins north through the Coast Ranges, with the major facies, of middle Miocene age pinching out north of San Francisco Bay. Nearly all phosphate-bearing strata are in Miocene or younger rocks. A few occurrences of pellets and nodules of Late Jurassic to Early Cretaceous age are found in the northern and central Coast Ranges. The most extensive phosphate-bearing deposits occur in a widespread facies of Luisian age, in which phosphate was deposited within shales and contiguous sandstones almost continuously from near San Francisco Bay to the northern Santa Ana Mountains, and from Point Conception to the Sierra Nevada foothills.—M.S.T.

10876 **Dickson, F. W.** Solubilities of metallic sulfides and quartz in hydrothermal sulfide solutions: Bull. Volcanol., v. 29, p. 605–628, illus., table, 1966.

Solubilities of cinnabar, stibnite, quartz, and orpiment in aqueous $Na_2S$ solutions were determined from 25° to 250°C, 1 to 2,000 bars, and several $Na_2S$ concentrations. Pressure increase decreases solubilities of the sulfides but slightly increases that of quartz. Temperature increase causes increased solubility above 150°C, but at lower temperature cinnabar, orpiment, and quartz show solubility decreases with increasing temperature. Quartz and cinnabar are mutually soluble, but only a small amount of cinnabar dissolves in the presence of stibnite. The second ionization constant of $H_2S$ is calculated to range from $10^{-16.2}$ at O°C to $10^{-12.59}$ at 250°C.—D.B.V.

10718 **Dickson, G. O.; Foster, J. H.** The magnetic stratigraphy of a deep sea core from the North Pacific Ocean: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 458–462, illus., 1966.

The inclination of the remanent magnetization has been determined for purposes of stratigraphic correlation on 377 specimens from a continuously sampled deep-sea sediment core. The sequence of normal and reversed polarity established by Cox et al (1964) is recognizable back to the Gilbert reversed epoch. The Cox et al time scale plotted against depth in core to the various reversal boundaries, assuming constant sedimentation for time greater than the known scale, gives ages of 4.0 and 4.35 m.y. for the first and second Gilbert events. The Jaramillo event (Doell and Dalrymple, 1966) is supported by the data but there is no evidence for the Gilsa event (McDougall and Wensink, 1966). No 180° reversals of the remanent vector were observed. It is emphasized that usable data may be obtained from deep-sea sediments that are not completely stable.—V.S.N.

10733 **Dietz, Robert S.; Sproll, Walter P.** Equal areas of Gondwana and Laurasia (ancient supercontinents): Nature, v. 212, no. 5067, p. 1196–1198, illus., table, 1966.

Difficulties in accounting for the present apparently random distribution of the continents are avoided to some extent if they have drifted from an earlier and more "logical" plan. In spite of many uncertainties in the calculations, measurements of the areas of the continents (as defined by the 1,000 fathom isobath) show that Laurasia and Gondwana were of almost identical size (100.7 and $100.6 \times 10^6$ $km^2$, respectively). The equal areas seem to argue for the reality of the two-supercontinent version of drift and against the Pangaea version, and for a simple drift history—even the possibility that the mid-Mesozoic breakup was unique in Earth history.

The originally equal areas can be explained in terms of mantle convection; the reason for the present distribution still remains enigmatic.—D.B.V.

**Ding, John Y. H.** *See* Ayers, H. D. 00892

00734 **Dodd, D. M.; Fraser, D. B.** Infrared studies of the variation of H-bonded OH in synthetic $\alpha$-quartz: Am. Mineralogist, v. 52, nos. 1-2, p. 149-160, illus., table, 1967.

The extinction coefficient at 3500 $cm^{-1}$ in the spectrum of $\alpha$-quartz is proportional to the H-bonded OH content. At this frequency and at a crystal temperature of about 300°K, infrared measurements were made on several thin Y-cut samples. The resulting maps show that the H-bonded OH content of the cultured material is not related to that of the seed; a relationship [is implied] between H-bonded OH content and growth rate. Changes in growth rate cause striations. Milky layers (inclusions of ordered water) develop in regions of originally higher extinction coefficient. There is a one to one correspondence between the extinction coefficient variations, the striation boundaries, and the refractive index gradients.—*from* Authors' abstract

00815 **Doelling, Hellmut H.** Escalante-Upper Valley coal area, Kaiparowits Plateau, Garfield County, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 20, 16 p., illus., table, 1967.

The Escalante-Upper Valley coal area study is a reconnaissance coal study presenting 110 measured coal sections, a measured stratigraphic section of the Straight Cliffs Sandstone, and 20 coal analyses. Coal seams are mapped on a scale of 1:24,000. All of the economic seams are located in the middle portion of the Straight Cliffs Sandstone where four coal zones are recognized. These zones can be traced throughout the area, in spite of the lenticular nature of the formation. Many localities contain several seams of minable coal with individual seams ranging up to 13 feet in thickness.—Author's abstract

10827 **Donath, F. A.** A triaxial pressure apparatus for testing of consolidated or unconsolidated materials subjected to pore pressure, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 41-51, illus., 1966.

To determine the effects of different stress states and pore pressure on the compaction of sediment and on the deformational behavior of rock, a triaxial apparatus was developed that permits control of pore pressure during triaxial testing of materials under high confining pressure. The apparatus is designed for use with 1-in. diameter by 2-in. length specimens subjected to confining pressures and pore pressures up to 30,000 psi and axial stress up to 130,000 psi. The axial load can be held constant or varied continuously during testing. The compact nature of the apparatus permits mobility that makes the apparatus particularly desirable where field testing is necessary.—Author's abstract

**Dondoli, C.** *See* Murata, K. J. 10861

**Donnay, J. D. H.** *See* Kennard, O. 00669

00710 **Donnelly, Thomas W.** Kinetic considerations in the genesis of growth twinning: Am. Mineralogist, v. 52, nos. 1-2, p. 1-12, illus., table, 1967.

Theories relating growth twins solely to accidents do not explain the fact that in some samples (i.e., albite from Paradox Limestone of New Mexico) 100 percent of the crystals are twinned, independent of the twinning, if any, of the nuclear grain. In other samples where both twinned and nontwinned crystals develop, the twinned crystals grow to larger size. It is suggested that growth-twinned overgrowths in authigenic albite result from interfacial kinetic competition, implying that such twinning may be predicted from kinetic considerations.—M.L.L.

10785 **Donnelly, Thomas W.** Geology of St. Thomas and St. John, U.S. Virgin Islands, *in* Caribbean geological investigations: Geol. Soc. America Mem. 98, p. 85–176, illus., tables, geol. map., 1966.

The oldest rock unit, Lower Cretaceous(?), is the Water Island Formation of flows and tuffs, overlain by the Virgin Island Group: Louisenhoj Formation of tuff and volcanic breccia with intercalated conglomerates; Outer Brass Limestone, thin bedded, carbonaceous, radiolarian, tuffaceous; Tutu Formation, coarse volcanic wacke of Louisenhoj debris and some limestone fragments; and poorly exposed Hans Lollik Formation. There was mild folding in Late Cretaceous or Early Tertiary time. Two sets of strike-slip faults trend northwest and northeast, and a set of normal faults north-south. Late intrusive rocks include dioritic plutons with hornfels aureoles, andesine porphyries, lamprophyre, breccia dikes, and a few pegmatites. Two chemical types of magmas were generated, with partial fusion and depression of upper mantle blocks linked with island arc deformation.—G.D.C.

00827 **Drake, Avery Ala, Jr.** Geologic map of the Easton quadrangle, New Jersey–Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-594, scale 1:24,000, sections, 1967.

00828 **Drake, Avery Ala, Jr.** Geologic map of the Bloomsbury quadrangle, New Jersey: U.S. Geol. Survey Geol. Quad. Map GQ-595, scale 1:24,000, sections, 1967.

10820 **Drake, Charles L.** Recent investigations on the continental margin of eastern United States, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 33–47, illus., 1966.

Geophysical measurements on continental margins between Cape Hatteras, N. C., and Halifax, Nova Scotia, have revealed two sediment-filled troughs, one on the continental shelf, the other under the continental slope and rise. These are separated by a basement ridge near the edge of the shelf. The area south of Cape Hatteras is more difficult to study due to the high-velocity carbonate rocks in the sedimentary section. Seismic refraction, reflection, and bore-hole data indicate the basic structure is similar to that to the north. A clue to the age of the basic structures may be found in a strike-slip fault with about 90 miles displacement found at lat. 40° N. Investigations ashore suggest that movement occurred at the end of Devonian time, indicating basement structures under the shelf and rise were in existence at that time.—*from* Author's abstract

00814 **Duedall, Iver W.; Weyl, Peter K.** The partial equivalent volumes of salts in seawater: Limnology and Oceanography, v. 12, no. 1, p. 52–59, illus., tables, 1967.

Partial equivalent volumes ($V_s$) of the major salts in sea water have been measured over the salinity range from 30 to 40 percent and a temperature range from 0 to 25°C. The experimental results, tabulated here, can be used to construct a density model of sea water by considering it a two-component system containing sea salt and water. Artificial sea water was used because natural contains small amounts of organic matter, nutrients, and trace elements that foul surfaces of dilatometer capillaries. A large temperature dependency of $V_s$ accounts for the high thermal expansion of sea versus pure water. Because $Na^+$ and $Cl^-$ comprise about 85 percent of the total mass of sea salt, there is a similarity in data for NaCl and sea salt; the sea salt curve is slightly lower.—G.D.C.

**Dugas, Jean.** *See* Sirois, Roger. 00837

00665 **Duguid, James O.; Lamb, Donald R.** Investigation of pavement performance in relation to geology: Wyoming Univ. Contr. Geology, v. 6, no. 1, p. 1–4, illus., tables, 1967.

The parameter that has the greatest effect on asphalt pavement behavior is the type of soil on which the pavement is constructed. Since the soils of Wyoming are primarily residual soils, it would be suspected that pavement performance in this state is related to geologic rock units. By applying statistical methods to pavement performance data taken from some 2,500 miles of highway, it was indicated that

certain pavement failures are related to soils formed from rocks of a particular geologic period [Mesozoic].—*from* Authors' abstract

**Dumbleton, M. J.** *See* Beaven, P. J. 10917

00771 **Durham, J. Wyatt.** Notes on the Helicoplacoidea and early echinoderms: Jour. Paleontology, v. 41, no. 1, p. 97–102, illus., 1967.

The new species *Polyplacus kilmeri, Waucobella nelsoni, Helicoplacus everndeni, and H. firbyi* are described [Lower Cambrian, California]. The new genera *Polyplacus* (type species *P. kilmeri*) and *Waucobella* (type species *W. nelsoni*) are established, and it is suggested that additional genera should be recognized. In addition to the nominate subclass Helicoplacida, the new subclass Polyplacida of the class Helicoplacoidea is proposed for *Polyplacus*, characterized by a helically organized test built of a mosaic of small plates. Sutural pores for "tubefeet" are demonstrable on each flank of the ambulacrum in *Waucobella* and indicate an internal radial water vessel in the Helicoplacoidea. It is suggested that such features of primitive echinoderms as epispires, diplopores, and porerhombs are ramifications of the water vascular system and had an internal central connecting plexus.—*from* Author's abstract

10770 **Durrell, Cordell.** Tertiary and Quaternary geology of the northern Sierra Nevada, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 185–197, illus., 1966.

Rocks of the northern Sierra Nevada include marine and continental sediments of volcanic and non-volcanic origin, lava flows, and intrusions, ranging in age from middle Eocene to Recent. Marine sediments are confined to the western edge of the range. Continental sediments are fluviatile, lacustrine, glacial, and volcanic and include fanglomerate, conglomerate, sandstone, and mudstone, tuff, tuff breccia, mudflow breccia, and ignimbrite. Lavas are olivine basalt and andesite, as are the plugs and dikes. Flows are far less abundant than clastic volcanics so that stratigraphic problems are as important as petrologic problems.—*from* Author's introduction

00640 **Eaton, Jerry P.** Instrumental seismic studies, *in* The Parkfield-Cholame, California, earthquakes of June-August 1966: U.S. Geol. Survey Prof. Paper 579, p. 57–65, illus., 1967.

Instrumental studies of the Parkfield–Cholame earthquakes have been aided by data recorded by the short-period Benioff seismograph at a long-term monitoring station at Gold Hill in Cholame Valley. The geometry of the aftershock zone was investigated by a small portable cluster of short-period, vertical-component, seismographs, and seismic refraction calibration of the region enclosing the aftershock source by means of 3 short reversed refraction profiles and a "calibration shot" near the epicenter of the main earthquake. Preliminary results indicate that the sudden slippage began about 8 km northwest of Parkfield and extended southeast along the San Andreas fault. Hypocenters of aftershocks in the southeastern half of the area were 2–12 km deep, almost directly under the surface trace of the main fracture zone.—V.S.N.

10761 **Eaton, Jerry P.** Crustal structure in northern and central California from seismic evidence, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 419–426, illus., table, 1966.

This article outlines the nature and limitations of the main seismic methods used in detailed investigations of the crust, reviews the seismic coverage available in northern and central California (mainly for the Sierra Nevada and the Coast Ranges), and summarizes the observations and results so far obtained. A longitudinal seismic refraction profile in the Sierra Nevada shows that the high southern part is underlain by a 54 km thick crust, which thins beneath the north end of the range and changes markedly in character at the Sierra Nevada boundary. A similar profile through the central Coast Ranges shows that the crust is only 22 to 25 km thick. Evidence from seismology on detailed structures of the crust

and upper mantle in northern California outside the regions described is almost nonexistent.—M.S.T.

**Edwards, K. W.** *See* Johnson, J. O. 00933

10885 **Egan, W. G.; Hallock, H. B.** Polarimetry signature of terrestrial and planetary materials, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 671–689, illus., table, 1966.

Terrestrial materials reveal polarization characteristics in reflected and emitted light which are functions of the phase and viewing angles of the surface, as well as the spectral range. The polarization characteristics are shown by all surfaces and are functions of the geometry and physical properties. Characteristic features of the percent polarization curve and the location of the plane of polarization as functions of phase and viewing angles can be listed as significant. These are the maximum and minimum percent polarization, phase angles where these occur, inversion angle, ratio of maximum to minimum polarization, and the rate of rise of polarization with phase angle. These properties serve to characterize any terrestrial surface. Data are presented to indicate the diversity of polarimetric signatures that are obtained on selected minerals and ores.—*from* Authors' abstract

**Eger, Donald T.** *See* Kemp, Warren C. 00670

00747 **Eichholz, Geoffrey G.; Galli, Ann N.** Determination of aluminum and magnesium by neutron activation analysis [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 72, 1967.

**Eiseley, Loren.** *See* Huxley, Thomas Henry. 00871

00915 **Eisler, J. D.** Near-surface spalling from a nuclear explosion in a salt dome: Jour. Geophys. Research, v. 72, no. 6, p. 1751–1760, illus., table, 1967.

Although near-surface spalling observed on the Salmon nuclear shot resembled that observed on other shots in different environments, the spalling process was more complex because of an artificially filled platform at surface zero. The Salmon maximum spall gap width (0.1 meter) in the vicinity of surface zero was roughly 1/6 of the width that would be expected without the platform. The radius was 460 meters, and the spalled layer thickness was 11.7 meters. Measurements established that the near-surface layers had experienced multiple bouncing rather than successive spallation.—Author's abstract

10723 **Elias, Maxim K.** Living and fossil algae and fungi, formerly known as structural parts of marine bryozoans: Palaeobotanist, v. 14, nos. 1–3, p. 5–18, illus., 1966.

Symbiotic or parasitic algae and fungi infest some ectoproct bryozoans. *Prochamaesiphon cummingsi* n.gen.n.sp., a blue-green alga, occurs as thalli in zooecia of *Nicholsonella cornula* (Middle Ordovician, Illinois); in the same host, *Ordovicimyces gallowayi* n.gen.n.sp., a fungus, occurs as hyphae and zoosporangia; Ordovicimyceae, n. fam., is proposed. *Prochamaesiphon geitleri* n.gen.n.sp., occurs as a single thallus in a zooecium of *"Batostomella" polyspinosa* (Upper Pennsylvanian, Nebraska); hyphae and reproductive bodies of the fungus *Propythium carbonarium* n.gen.n.sp. are common in the same host. Four new living species are described. Fungal order Saprolegniales and its families Monoblepharaceae and Pythiaceae are emended; Heteroporinyceae, n.fam., is proposed for a new living species.—V.M.J.

10889 **Ellermeier, A. K.; Fung, A. K.; Simonett, D. S.** Some empirical and theoretical interpretations of multiple polarization radar data, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 657–670, illus., 1966.

Interpretation of radar backscatter return is a valuable tool to the earth-scientist. Experiments using aircraft-borne polypolarization radars indicate that terrain phenomena are identifiable and inferences may be drawn as to compositional nature

of these phenomena. Theoretical work has shown that: The direct polarized backscattered radar signal is proportional to the product of the appropriate Fresnel reflection coefficient and the sum of the cosine of the angle of incidence and a slope term measured along the terrain profile in the plane of incidence; the cross polarized backscattered radar signal is proportional to the product of the sum of the two Fresnel reflection coefficients and the slope measured along the profile perpendicular to the incident plane. A measure of surface roughness can be obtained by proper instrumentation of direct and cross polarized components of the signal return.—*from* Authors' abstract

10746 **Emerson, D. O.; Rich, E. I.** Field trip—Sacramento Valley and northern Coast Ranges, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 473–485, illus., 1966.

This trip provides an opportunity to see typical Late Cretaceous and Jurassic sedimentary and volcanic rocks of the western Sacramento Valley and northern Coast Ranges, as well as Lower Cretaceous "sedimentary" and intrusive masses of serpentine, an unusually interesting major mercury mine, the Sulphur Bank mine, a late Tertiary and Quaternary volcanic field around Clear Lake, and the rocks of the Sonoma Volcanic Series.—M.S.T.

00864 **Englebright, Steven C.; Pickering, Samuel M., Jr.** A Cambrian hyolithid fauna from the Conasauga Group of Floyd County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 90, 1967.

00650 **Englund, Kenneth J.; Huddle, John W.; DeLaney, A. Otis.** Geologic map of the West Liberty quadrangle, Morgan County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–589, scale 1:24,000, section, text, 1967.

Mineral resources of potential economic interest in West Liberty quadrangle include coal, natural gas, oil, flint clay, and limestone; only coal and natural gas have been developed commercially. Coal is of high volatile A or B bituminous rank and occurs in beds ranging in thickness from a few inches to five feet; in ascending order the principal beds are the Bruin, Grassy, Little Caney, Cannel City, Fire Clay, and Index. About 50 holes have been drilled in the past 50 years for oil and gas; tests were concentrated at West Liberty and south of Shoals Branch. Gas has been produced from the Silurian or Devonian "Corniferous" limestone at both these sites where low domes are indicated. Two previously unmapped faults with normal movement and rocks downthrown to the southeast are noteworthy.—M.C.M.

**Epstein, Samuel.** *See* Garlick, G. Donald. 00702

**Espinosa, A. F.** *See* Sato, R. 00869

00796 **Evans, Robert.** The structure of the Mississippian evaporite deposit at Pugwash, Cumberland County, Nova Scotia: Econ. Geology, v. 62, no. 2, p. 262–273, illus., tables, 1967.

Four salt beds (two depositional cycles) of the Mississippian Windsor Group approach the surface in the core of a doubly plunging anticline flanked by rocks of the Pennsylvanian Pictou Group. The evaporites have been strongly deformed, and many folds, large and small, some doubly plunging, and others refolded, have been mapped; axes and axial planes have steep to gentle plunges and dips. Axial planes of these minor folds have an average strike similar to that of the anticline affecting the Pictou Group, and suggest that folding of the evaporites was synchronous with folding of the Pictou.—W.S.W.

**Evans, S.** *See* Rinker, J. N. 10881

**Evenson, R. E.** *See* Poland, J. F. 10734

00872 **Everett, F. D.; Bennett, H. J.** Evaluation of domestic reserves and potential sources of ores containing copper, lead, zinc and associated metals: U.S. Bur. Mines Inf. Circ. 8325, 78 p., illus., tables, 1967.

Estimated reserves of recoverable copper, lead, and zinc in the United States exploitable at the cost-price ratio existing in 1964 are 74.7, 30.6, and 22 million tons of metal, respectively. Corresponding amounts of the metals in potential (submarginal) resources in known bodies of mineralized rock are 57.2, 14.5, and 58.3 million tons. Tables show the distribution of these reserves and resources among eight regions and the quantities of gold and silver associated with the base metals. Economic factors related to resources, production trends, estimated future consumption, and industry problems are reviewed.—A.P.B.

**Evernden, J. F.** *See* Mansfield, R. H. 10670

10822 **Ewing, J. I.; Ewing, Maurice; Leyden, Robert.** Seismic profiler survey of the Blake Plateau, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 58-61, illus., 1966.

Seismic reflection profiles on Blake Plateau have been correlated with sediment cores, seismic refraction data, and well logs on Florida to study the structural relationship between the Florida Peninsula, the continental shelf, and the plateau. Results indicate that the Blake-Bahama-Florida area was receiving sediments behind a barrier reef until late Mesozoic. Death of the reef and subsidence resulted in the present submerged plateau. Four strong reflectors were observed in the plateau sediments. The Tertiary sediments on the plateau form a wedge, 1,200 m thick on the west side and 200-300 m thick near the escarpment on the east. Extension of the Cape Fear Arch onto the plateau diverts the flow of the Gulf Stream so that much of the plateau is being eroded. The eroded material has been swept off the plateau to form the Blake-Bahama outer ridge.—*from* Authors' abstract

**Ewing, Maurice.** *See* Kuo, John T. 10681

**Ewing, Maurice.** *See* Ewing, J. I. 10822

**Fairbairn, H. W.** *See* Moorbath, S. 00795

10857 **Fairchild, John C.** Correlation of littoral transport with wave energy along shores of New York and New Jersey: U.S. Army Corps Engineers Coastal Eng. Research Center Tech. Memo. 18, 35 p., illus., tables, 1966.

This office study correlating certain field measurements of net littoral transport with the average net alongshore component of wave energy, is carried out through a survey attempt toward a useful "wave energy-littoral transport" correlation for a 500-mile stretch of the North Atlantic Coast, by applying wave refraction analysis aided by interpolation techniques to waves hindcast from synoptic weather charts. Littoral transport rates were obtained from beach erosion control and other applicable reports. Results of the correlation are presented in tabular and graphical form and compared to other "wave energy-littoral transport" relations. The conclusion is made that correlation should be reliable within the limits of data scatter.—*from* Author's abstract

**Fairhurst, C.** *See* Crouch, S. L. 00804

**Fairhurst, Charles.** *See* Berry, D. S. 10907

00721 **Fatt, Irving.** La struttura dei pori nelle rocce sedimentarie e la sua influenza sulla conduttivita elettrica e sulla permeabilita ar fluidi: Scuola Azione 1967, no. 4, p. 96-142, illus., 1967.

Model studies of fluid flow in porous sedimentary rocks in relation to pore structure are reported. It is assumed that porosity of the model is not influenced by the nature and surface of the matrix, the modeled rock is inert to the fluid contained in the pores, and the porous structure is representative of a typical rock. Properties of the matrix and interface between pores and matrix and effects on porosity are examined for models with various dispositions of pore space (cubic, rhombic, hexagonal); results are illustrated graphically. The effects of external pressure (from various directions) on the formation factor, and on relations between porosity,

electric conductivity, and permeability are examined. Examples are cited from the Tensleep Sandstone of Wyoming and from the Tuscaloosa Sandstone in Mississippi.—V.S.N.

**Fay, Marie J.** *See* Mallett, Gavin R. 10925

**Fellows, Larry D.** *See* Vineyard, Jerry D. 00807

00704 **Fenner, P.; Hagner, A. F.** Correlation of variations of trace elements and mineralogy of the Esopus Formation, Kingston, New York: Geochim. et Cosmochim. Acta, v. 31, no. 2, p. 237–261, illus., tables, 1967.

In the area studied, the Esopus Formation is composed of three, or locally, two members which are distinguished in terms of petrographic and field characteristics. X-ray diffraction data and spectrographic analyses are used to strengthen the meaning of this subdivision and to define the Esopus Formation and separate it from enclosing stratigraphic units.—D.B.V.

00934 **Fenwick, K. G.** Feaver Lake area (Fredart–Whitemud Lakes area), District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 410, scale 1 in. to 1/4 mi., text, 1967.

Bedrock of the Fredart–Whitemud Lakes area is Precambrian, overlain by chiefly Pleistocene unconsolidated till, sand, gravel, and clay. Three prominent metasedimentary belts consist of impure quartzite, arkose, slate, greywacke and derived schists, together with banded iron formation. Metavolcanics are greenstone intercalated with thin belts of tuffs, mafic sediments and banded iron formation. Diorite, gabbro and peridotite dikes, sills and irregular masses have intruded both the metavolcanics and metasediments and are intruded by granitic rocks which occupy the areas between the metasedimentary belts. Youngest rocks are diabase dikes. Major rock units of metasedimentary belts trend east-northeast; no major faults were recognized. Exploration has shown a 300 ft-wide iron formation with iron content of 20 percent, and copper and silver mineralization to depths of over 500 feet and over a length of 1,500 feet.—M.C.M.

00935 **Fenwick, K. G.** Bluffy Lake area (Fredart–Whitemud Lakes area), District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 411, scale 1 in. to 1/4 mi., text, 1967.

The text for the Fredart–Whitemud lakes area is abstracted with the citation for the Feaver Lake area (see Fenwick, Map 410).—M.C.M.

00936 **Fenwick, K. G.** Whitemud Lake area (Fredart–Whitemud Lakes area), District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 412, scale 1 in. to 1/4 mi., text, 1967.

The text for the Fredart–Whitemud Lakes area is abstracted with the citation for the Feaver Lake area (see Fenwick, Map 410).—M.C.M.

00913 **Ferguson, H. F.** Valley stress release in the Allegheny Plateau: Eng. Geology, v. 4, no. 1, p. 63–71, illus., 1967.

Recent foundations exposed during construction of flood control and navigation dams in flat lying rocks of the Allegheny Plateau have disclosed release of stress in valley walls and bottom. These valleys, cut into sediments of variable hardness, show compression faults in the bottoms and tension fractures in the walls. Generally, the tension fractures are vertical or nearly so, and parallel the valley strike. The distance between fractures is a function of the competency and thickness of the stratigraphic unit. Valley bottoms have been subject to compression forces produced by that zone of the valley walls that has fractured and expanded horizontally. This horizontal movement together with the load of this mass, produces wedge failure of the walls and bottom in the form of arching, thrust faulting or shear breaks.—M.S.T.

00929 **Fett, John D.; Hamilton, Douglas H.; Fleming, F. A.** Continuing surface displacements along the Casa Loma and San Jacinto faults in San Jacinto Valley, Riverside County, California: Eng. Geology, v. 4, no. 1, p. 22–32, illus., 1967.

Evidence of surface displacement and differential elevation changes related to movement along the San Jacinto and Casa Loma faults includes the escarpments in Recent sediments along the faults, a history of recurrent cracking, offsetting, repairing and regrading of roads across faults, formation of sink holes in alluvial sediments along parts of the faults, and comparative leveling data showing subsidence of the block between the two faults. Observed movements along these faults and down-dropping of the San Jacinto Valley may be attributable to the effects of ground-water withdrawal from the pressure aquifer underlying the valley. The possibility exists that the fault movements are part of a continuation of the tectonic processes responsible for the origin and development of the San Jacinto Valley.—M.S.T.

00636 **Finch, Warren I.** Geology of epigenetic uranium deposits in sandstone in the United States: U.S. Geol. Survey Prof. Paper 538, 121 p., illus., tables, 1967.

The geology of epigenetic uranium deposits in sandstone and related rocks of the United States, is summarized on the basis of field examinations from 1949 through 1961 and of more than 1,000 published and unpublished reports. Most deposits are tabular layers, nearly parallel to the bedding, called peneconcordant deposits; orebodies range from small masses to those containing a million tons or more. Nearly all peneconcordant deposits are in beds of Devonian age or younger and correlate with development of woody land plants. Most probably had a similar origin although differing in detail from place to place; metals were derived from trace amounts in porewaters as the host rocks accumulated and from solution during diagenesis. Solutions moved through the rocks and precipitated metals in strong reducing environments. Some vein deposits are probably hydrothermal from a hypogene source. Deposits examined are tabulated.—V.S.N.

00738 **Finney, J. J.; Nagaraja Rao, N.** The crystal structure of cheralite: Am. Mineralogist, v. 52, nos. 1–2, p. 13–19, illus., tables, 1967.

The structure of cheralite, a thorium, calcium, rare earth monazite, has been completely redetermined. Patterson sections and three-dimensional difference maps were used to determine the atomic positions, and least squares refinement of the data reduced the R-factor to 0.084. This structure is in accord with three of four previous monazite structure analyses, and the crocoite structure analysis. A relationship is apparent between increase of long Ce—O bonds and decrease of short Ce—O bonds and P—O bonds.—Authors' abstract

00899 **Firby, James R.** Pliocene nonmarine mollusks from Contra Costa County, California: California Acad. Sci. Proc., ser. 4, v. 34, no. 14, p. 511–524, illus., table, 1967.

Nonmarine mollusks are described from Pliocene lacustrine beds of the Siesta Formation and the riparian "Mulholland beds" which crop out in the Berkeley Hills, Contra Costa County, Calif. Pelecypods described are *Anodonta nuttalliana lignitica* Cooper, 1894, and *Sphaerium cynodon* Hanna, 1923. Gastropods from the genera *Lymnaea, Gyraulus, Helminthoglypta, Deroceras, and Goniobasis* are described.—M.S.T.

10892 **Fischer, William A.** Geologic applications of remote sensors, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 13–19, illus., tables, 1966.

The selection and application of remote sensor instruments to geologic problems is discussed. Comparison is made of the unique properties and applications of the camera, colorimeter, and the eye in a color observation system. Although each has unique advantages and disadvantages, they are mutually supporting.—*from* Author's summary

00881 **Fisher, David E.** Cosmogenic tritium problem in iron meteorites: Jour. Geophys. Research, v. 72, no. 4, p. 1351–1354, illus., tables, 1967.

Pieces of the Sikhote Alin iron meteorite have been irradiated with reactor neutrons to induce the $He^3$ (n,p) $H^3$ reaction. The diffusive behavior of this $H^3$ has been measured as a function of time and of temperature. The results show that the low cosmogenic $H^3$ content of iron meteorites is not due to $H^3$ loss during atmospheric descent, but to diffusion loss at ordinary temperatures during the terrestrial residence time of the meteorites.—Author's abstract

00662 **Fisher, Frederick S.** Geology of the Stinkingwater mining region, Park Co., Wyoming—Pt. 1, General geology and petrology of Tertiary intrusive rocks: Wyoming Univ. Contr. Geology, v. 6, no. 1, p. 71–86, illus., tables, geol. map, 1967.

Multiple intrusions of dioritic to granodioritic rocks have domed, fractured, and metamorphosed rocks of the Early Basic Breccia, Early Basalt Flows, and Wiggins Formation in the Stinkingwater region. The oldest and largest intrusive body is fine- to medium-grained granodiorite to diorite. Faulting and fracturing, stoping, assimilation, and doming all played a role in the process of emplacement of the plutons, with no single process dominant. Cumulative thickness of volcanic sediments and extrusive material is approximately 5,000 feet. The Wiggins Formation and Early Basalt Flows are offset a few hundred feet along high angle faults. Intrusive rocks were probably derived from the same parent magma as part of a calc-alkalic series; at one time the area may have been a center for extrusive volcanic material and present intrusives may represent plugs filling an old vent area.—*from* Author's abstract

10721 **Fisher, Richard V.** Rocks composed of volcanic fragments and their classification: Earth-Sci. Rev., v. 1, no. 4, p. 287–298, illus., tables, 1966.

Changes and additions to pyroclastic classification and nomenclature since the reviews of Wentworth and Williams (1932) and of Blythe (1940) have dealt mainly with processes of pyroclastic flows and the ignimbrites formed from the flows. Fundamental disagreements in volcanoclastic names as used throughout the world arise from disagreements or misconceptions about such common terms as *sedimentary, volcanic, epiclastic, and pyroclastic*. Epiclastic and pyroclastic refer to different processes of fragmentation, not to processes of deposition, and, thus, are not synonyms of sedimentary and volcanic. No international agreement on classification can be reached until universally acceptable definitions are agreed upon for these four terms.—V.S.N.

00836 **Fisher, W. L.; Rodda, Peter U.** Lower Cretaceous sands of Texas—Stratigraphy and resources: Texas Univ. Bur. Econ. Geology Rept. Inv. 59, 116 p., illus., tables, geol. map, 1967.

Lower Cretaceous sand, important as fresh-water aquifers and as sources of industrial or silica sands, are extensive in north-central, northern, and west-central Texas, occurring in separate sequences recognized by changes in facies and presence or absence of associated limestone units. North-central outcrops consist of Twin Mountains, Glen Rose, and Paluxy Formations; subsurface are Hosston, Sligo, Pearsall, Hensel, and Glen Rose Formations. Central outcrops are locally differentiated Travis Peak Formation overlain by the Glen Rose. Northern and west-central outcrops are equivalents of the Twin Mountains, Glen Rose, and Paluxy, considered as one unit—Antlers Formation. A few deposits meet purity and grain size specifications with minimum beneficiation; about one-third of those investigated would require more extensive beneficiation.—G.D.C.

10774 **Flawn, Peter T.** Mineral resources—Geology, engineering, economics, politics, law: Chicago, Ill., Rand McNally and Company, 406 p., illus., tables, 1966.

This book attempts to relate geology, engineering, economics, politics, and law to mineral resources. Subjects included in the various chapters deal with the nature and production of mineral resources; formation and classification of their deposits; lessons from ancient history, renaissance, and modern industrial developments.

ownership of deposits and government relations; ecological effects of mining; occurrence, distribution, and economic outlook; and future supplies.—G.D.C.

**Fleming, F. A.** *See* Fett, John D. 00929

**Foster, J. H.** *See* Dickson, G. O. 10718

10719 **Foster, John H.** A paleomagnetic spinner magnetometer using a fluxgate gradiometer: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 463–466, illus., 1966.

A spinner magnetometer for paleomagnetic research consisting of a 5 cps spinner shaft, a fluxgate gradiometer pickup, and a phase sensitive voltmeter is described. A major consideration in the design of the system is that it may be duplicated with a minimum of available technical facilities. A discussion is given of possible improvements in sensitivity. The present sensitivity is $1 \times 10^{-7}$ emu/cm$^3$ for an 11.5 cm$^3$ specimen.—Author's abstract

**Foster, John H.** *See* Ninkovich, Dragoslav. 10789

10870 **Fournier, R. O.; Rowe, J. J.** The deposition of silica in hot springs: Bull. Volcanol., v. 29, p. 585–587, 1966.

Large amounts of silica are likely to be deposited in hot spring systems only after the solubility of amorphous silica has been exceeded. Cristobalite and chalcedony probably form in hot spring systems only by crystallization of previously deposited silica gel. The solubility of quartz in water rises with increasing temperature to a maximum of 725 ppm at 330°C, but the maximum amount of silica likely to occur where quartz precipitates at depth is appreciably greater. The dissolved silica content of 90 hot spring waters from Yellowstone National Park appears to be controlled by dissolution, deposition, or alteration of other silica-bearing phases at depth. The silica content of surface waters allows an estimate of the temperatures at which these waters were last in equilibrium with quartz at depth.—D.B.V.

00653 **Fournier, Robert O.** The porphyry copper deposit exposed in the Liberty open-pit mine near Ely, Nevada—Pt. 1, Syngenetic formation: Econ. Geology, v. 62, no. 1, p. 57–81, illus., tables, 1967.

A monzonite porphyry complex was intruded into folded Paleozoic limestone and shale during Cretaceous faulting. In the northeastern porphyry, described in this paper, the upper parts of the complex solidified first and were subsequently intruded and altered by injections of magma from below. Biotite, muscovite, and montmorillonite are the principal alteration products; plagioclase was altered to K-feldspar or, later, to muscovite, but primary K-feldspar was not altered. Chalcopyrite, the principal primary copper mineral, formed mostly as a syngenetic constituent of the porphyry groundmass during final consolidation; smaller amounts occur in veins near intrusive contacts. Lack of equilibrium between phenocrysts and groundmass K-feldspar suggests water fugacity kept low by formation of hydrous minerals.—W.S.W.

00793 **Fournier, Robert O.** The porphyry copper deposit exposed in the Liberty open-pit mine near Ely, Nevada—Pt. 2, The formation of hydrothermal alteration zones: Econ. Geology, v. 62, no. 2, p. 207–227, illus., tables, 1967.

Alteration products and primary sulfides in the southwestern porphyry show a zonal pattern spatially related to fissures and pyrite-bearing veins. The outer zone has unaltered K-feldspar and kaolinite after plagioclase; the middle zone contains 2M mica and K-feldspar after plagioclase, and copper sulfides; and the inner zone has 2M mica and quartz after all other silicates. Primary hornblende goes to biotite, which becomes increasingly Fe-poor, presumably as iron enters sulfides. The apparently stable assemblage kaolinite-K-feldspar, which normally reacts to form muscovite, is believed to be stabilized at high pressures and temperatures below 250°C by silica supersaturation comparable to that represented by amorphous or gelatinous silica.—W.S.W.

**Frantti, G. E.** *See* DeNoyer, John M. 10694

**Fraser, D. B.** *See* Dodd, D. M. 00734

00856 **Friend, Jennifer K.; Riedel, William R.** Cenozoic orosphaerid radiolarians from tropical Pacific sediments: Micropaleontology, v. 13, no. 2, p. 217–232, illus., 1967.

A new system of generic classification is proposed for the Orosphaeridae, a radiolarian family apparently restricted to the Cenozoic. *Orodapis, Oropagis, and Orostaurus* are described as new genera, and *Orodendrum* Haeckel and *Oroscena* Haeckel are redefined. Most of the taxa considered here (six genera and seven species) have stratigraphic ranges of only one or two epochs, and it is concluded that the family is potentially useful stratigraphically, especially in sparsely fossiliferous pelagic sediment sequences.—Authors' abstract

**Frommer, D. W.** *See* Heising, L. F. 00750

**Fun-Den-Wang.** *See* Street, Norman. 10829

**Fung, A. K.** *See* Ellermeier, A. K. 10889

10863 **Funkhouser, J. G.; Barnes, I. L.; Naughton, J. J.** Problems in the dating of volcanic rocks by the potassium-argon method: Bull. Volcanol., v. 29, p. 709–717, illus., tables, 1966.

Dates obtained by the K-Ar method on whole rocks and included minerals frequently show gross discordances. An attempt is made here to trace the sources of these anomalies. Results from a rhyodacite from Oahu, Hawaii, are reported. Determinations on several minerals and whole rock give a concordant age of 2.3±0.3 m.y., excluding some few results on minerals which show old age anomalies. It is found that gas released from fluid inclusions by crushing contains radiogenic argon, and the presence of such gaseous inclusions in a sample produces anomalously old ages (about 880 m.y.). Therefore phenocryst-containing materials should be examined for fluid inclusion content, and samples containing these should be rejected.—D.B.V.

00895 **Gabrielse, H.** Tectonic evolution of the northern Canadian Cordillera: Canadian Jour. Earth Sci., v. 4, no. 2, p. 271–298, illus., table, 1967.

A late Proterozoic tectonic framework in the northern and eastern parts of this region persisted until mid-Devonian time. Late Paleozoic deposition was influenced by a late Devonian or early Mississippian orogeny producing coarse clastic sediments in the northern and western parts and by a late Pennsylvanian orogeny in northern Yukon. The Cassiar and Coast Geanticlines, late Triassic, controlled distribution and character of Mesozoic strata southwest of Tintina and Rocky Mountain Trenches. Metamorphism and granitic intrusion were concentrated along these geanticlines. Mesozoic and Tertiary plutonic activity, at intervals of 30 m.y., was accompanied by deformation and regional unconformities. Crustal shortening has been much less in Mackenzie Mts. than in southern Rockies; a marked change in structure occurs near Liard River in the eastern Cordillera.—G.D.C.

**Gabrielse, H.** *See* Norford, B. S. 10915

**Galli, Ann N.** *See* Eichholz, Geoffrey G. 00747

10762 **Galloway, Alan J.** Field trip—Point Reyes Peninsula and San Andreas fault zone, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 429–440, illus., 1966.

The author outlines an itinerary for a field trip starting at Golden Gate Bridge, and going north to Stinson Beach, Olema, Bear Valley, Inverness, Drakes Beach, Point Reyes Lighthouse, Samuel P. Taylor State Park, Greenbrae, and return to San Francisco. Stops are included to examine Franciscan rocks, parts of the San Andreas fault scarp line, regional structures, Tertiary beds lying on quartz diorite, and a Paleocene conglomerate.—M.S.T.

**Ganapurthy, R.** *See* Kuroda, P. K. 00681

00702 **Garlick, G. Donald; Epstein, Samuel.** Oxygen isotope ratios in coexisting minerals of regionally metamorphosed rocks: Geochim. et Cosmochim. Acta, v. 31, no. 2, p. 181–214, illus., tables, 1967.

Regularities in the relative O-18/O-16 ratios of coexisting quartz, garnet, ilmenite, and magnetite from a number of regionally metamorphosed rocks suggest that these minerals crystallized in isotopic equilibrium. Quartz–magnetite fractionations decrease with increasing metamorphic grade, except in a few rocks showing evidence of retrograde metamorphism. It is estimated that pelitic schists containing kyanite and chloritoid or staurolite crystallized at 520°–600°C. Local homogeneity in isotopic composition of particular minerals among dissimilar rocks is observed in some areas, and is attributed to isotopic exchange with mobile pore-fluids during metamorphism.—D.B.V.

10792 **Garlick, G. Donald.** Oxygen isotope fractionation in igneous rocks: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 361–368, illus., table, 1966.

The O-18/O-16 ratios of coexisting silicate minerals in igneous and metamorphic rocks are approximately proportional to the chemical index: Si+0.58 Al equivalents/total cation equivalents. Measured phenocryst groundmass isotopic fractionations in volcanic rocks are negligible when corrected for differences in chemical indices. Apparently, solid and liquid silicates of equivalent chemistry do not fractionate isotopes of oxygen with respect to one another. Isotopic zoning within phenocrysts and whole-rock isotopic variations accompanying magmatic differentiation are thus expected to be minimal and due to variations in chemical index. Isotopic fractionations among minerals in plutonic rocks are considerably larger than in volcanic rocks. Continental plutonic rocks are enriched in O-18 relative to oceanic volcanic rocks of equivalent chemistry.—*from* Author's abstract

00835 **Garner, L. E.** Sand resources of Texas Gulf Coast: Texas Univ. Bur. Econ. Geology Rept. Inv. 60, 85 p., illus., tables, geol. map, 1967.

The Gulf coast area of Texas, about 23,000 sq mi, is underlain by alluvial, deltaic, beach, and eolian deposits of Pleistocene and Recent age, in intermixed and interbedded deposits. Sand bodies are irregular in size and shape, and vary in physical character and mineralogical and chemical composition. Pleistocene sand deposits occur in the Willis, Lissie, Montgomery, and Beaumont Formations which underlie coastwise terraces or erosional surfaces. Recent sands are currently being deposited along the modern coast and major streams. This report includes 26 counties, of which Columbus, Hardin, and Liberty have current sand production; most other deposits require beneficiation to meet industrial specifications. Most counties have some sand or gravel production.—G.D.C.

**Gast, P. W.** *See* Goldich, S. S. 10891

10767 **Gay, Thomas E., Jr.** Economic mineral deposits of the Cascade Range, Modoc Plateau, and Great Basin region of northeastern California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 97–104, illus., 1966.

The principal mineral commodities of the region, all of which are directly related to its volcanic terrane, are volcanic cinders, pumice and pumicite, and crushed stone. Volcanic products of potential importance are tuffaceous stone, perlite, and obsidian. Metallic commodities are lacking, although three minor gold districts, minor showings of mercury, traces of copper, and one small uranium deposit are known. Peat deposits are being utilized, diatomite is as yet unused, and salt has not been used for years. Sand and gravel are used locally for aggregate.—M.S.T.

10821 **Geddes, Wilburt H.; Watkins, Joel S.** Atlantic Shelf magnetic anomaly, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 48–56, illus., 1966.

The Atlantic Shelf magnetic anomaly is a linear anomaly that extends from Newfoundland to Florida, and closely parallels the edge of the continental shelf.

The anomaly becomes quite complex south of Charleston, S. C., where it splits into several linear anomalies. At least one of these branches has no associated topographic feature. An intrusive–extrusive igneous rock complex probably causes the magnetic anomaly. Geophysical data imply that the basement ridge is a buried island arc. Southeast of the Bahama Islands, a linear anomaly can be traced for 200 miles and is clearly associated with the outer ridge north of the Puerto Rico Trench. The shelf anomaly and the outer ridge anomaly appear to be related.—Authors' abstract

**Gemperle, Michael.** *See* Dehlinger, Peter. 00868

10788 **Gentry, Robert V.** Alpha radioactivity of unknown origin and the discovery of a new pleochroic halo: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 453–454, illus., 1966.

Research on radioactive halos in biotite has revealed several pleochroic halos of anomalous radii which it is not possible to relate to uranium or thorium decay series alpha emitters. This new halo (type G) is concluded to represent alpha radioactivity of unknown origin which at one time existed in the Earth's crust.—V.S.N.

**George, P. T.** *See* Bennett, G. 00916

**George, P. T.** *See* Bennett, G. 00924

**George, P. T.** *See* Bennett, G. 00943

**George, P. T.** *See* Bennett, G. 00944

10724 **Gerstenhauer, Armin.** Beiträge zur Geomorphologie des mittleren und nördlichen Chiapas (Mexico) unter besonderer Berücksichtigung des Karstformenschatzes: Frankfurter Geog. Hefte 41, 91 p., illus., tables, 1966.

The geomorphic divisions of Chiapas, described here, include prairies, steppes, the Rio Grijalva valley, highland of San Cristóbal Las Casas, the Tertiary mountainland of North Chiapas, and the Gulf Coastal Plain. Their features, including cuestas and fault scarps, are indicated on one sketch map, the underlying major geologic units on another. The section on genesis of the tropical karst includes the character and significance of the soils, formation of cones and poljes, and water analyses. Photographs illustrate different types of landscape.—G.D.C.

00735 **Glatz, Alfred C.** The $Bi_2Te_3$–$Bi_2S_3$ system and the synthesis of mineral tetradymite: Am. Mineralogist, v. 52, nos. 1–2, p. 161–170, illus., tables, 1967.

A phase equilibria study of the $Bi_2Te_3$–$Bi_2S_3$ pseudobinary system has demonstrated that this system contains two compounds, a congruent melting $\gamma$ phase (called $\gamma$-tetradymite) and an incongruent $\beta$ phase (called $\beta$-tetradymite), as well as a region of solubility of $Bi_2S_3$ in $Bi_2Te_3$. The phase diagram is correlated with previous observations, including studies of the mineral "tetradymite." A mineral sample from Paonia, Colo. was identified as $\gamma$-tetradymite.—Author's abstract

00927 **Gleeson, C. F.; Tupper, W. M.** Coding system and data cards used in reconnaissance geochemical surveys: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 723, p. B52–B54, illus., table, 1967.

A field card and a coding system devised for electronic data processing of geochemical data are described, and advantages of electronic processing of reconnaissance programs are reviewed. The system was developed to process data from heavy mineral surveys in the Keno Hill area, Yukon Territory and in the Bathurst area, New Brunswick. The field card has an 80-character base.—V.S.N.

00770 **Globensky, Yvon.** Middle and Upper Mississippian conodonts from the Windsor Group of the Atlantic Provinces of Canada: Jour. Paleontology, v. 41, no. 2, p. 432–448, illus., table, 1967.

Conodonts have been obtained from insoluble residues of limestones from the Windsor Group (Valmeyeran–Chesterian) of the Atlantic Provinces of Canada. From this fauna 12 genera and 35 species have been identified of which *Hindeodella bretonensis, Ozarkodina acadiensis, Mestognathodus dhuensis, Cavusgnathus windsorensis, and Gnathodus scotiaensis* are new; *Gnathodus girtyi intermedius* is a new subspecies. Genus *Mestognathus* is reported for the first time in North America. The conodont fauna indicates a Middle to Late Mississippian age for the Windsor Group; Middle Mississippian age is more probable. Comparison with European literature suggests an age in the middle Visean–lower Namurian range. Locally, different subzones of the Windsor Group are characterized by species that have restricted ranges. The author suggests that the Skir Dhu beds of northeastern Cape Breton Island belong to Subzone E of the Windsor type area.—*from* Author's abstract

00860 **Göke, Gerhard.** *Neoprobolium oklahomae* (Richardson): Aufschluss, v. 18, no. 3, p. 96–97, illus., 1967.

The trilobite genus *Neoprobolium* Struve 1958 is known to occur only in the Lower Devonian of Europe and North America. The illustrated species *N. oklahomae* is abundant in the Haragan Formation of Helderbergian limestones of Oklahoma, however, only fragments, mostly cephalic and caudal sheaths, are found. Entire specimens are very rare. The Helderbergian represents the oldest Lower Devonian in North America. Several other trilobite and ostracod fauna are associated with *Neoprobolium*.—G.D.C.

00896 **Gold, L. W.** Influence of surface conditions on ground temperature: Canadian Jour. Earth Sci., v. 4, no. 2, p. 199–208, illus., 1967.

Ground temperatures at Ottawa were measured at depths up to 8 m under two parking lots, one of which was cleared of snow in winter; the surface temperatures were compared with monthly and annual surface and air temperatures measured at a nearby grassed site. A dependence of the difference upon snow cover and convective loss was observed, and a correlation was found to exist between the monthly average of the daily global radiation and the difference between monthly average air temperature and monthly average parking lot surface temperature. Because of a change in surface conditions, it was shown, there was a change in annual average ground temperature beneath a parking lot. The observations are discussed with reference to sporadic permafrost.—G.D.C.

**Goldich, S. S.** *See* Stern, T. W. 10793

10891 **Goldich, S. S.; Gast, P. W.** Effects of weathering on the Rb–Sr and K–Ar ages of biotite from the Morton Gneiss, Minnesota: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 372–375, illus., tables, 1966.

Weathering has drastically reduced the Rb–Sr and, to a lesser extent, the K–Ar age of biotite from the Morton Gneiss of southwestern Minnesota. The ages are approximately 75 percent and 25 percent lower than the corresponding ages for biotite from the fresh gneiss. The effects of even incipient weathering cannot be neglected in Rb–Sr dating of biotite and, by analogy, of feldspar and whole-rock samples.—Authors' abstract

**Goodacre, A. K.** *See* Weber, J. R. 10709

00883 **Goodwin, A. M.** Volcanic studies in the Birch–Uchi Lakes area of Ontario: Ontario Dept. Mines Misc. Paper MP 6, 96 p., illus., tables, 1967.

The volcanic rocks of the Birch–Uchi Lakes area in northwestern Ontario are arranged in superimposed cycles, each cycle displaying a progression from mainly basic effusives upward to mostly acid to intermediate extrusives. Sediments are mostly associated with the acid to intermediate extrusive phases. Parts of two cycles are present. Basalt, which forms nearly half the volcanic sequence, is mainly tholeiitic. Andesite, dacite, rhyodacite, and rhyolite, present mainly in pyroclastic forms, are the calc-alkalic suite. Gold is preferentially distributed; stratigraphically, most of it occurs in the upper acid part of the lower volcanic cycle, and lithologically

it is found with interbanded rhyolite-dacite pyroclastics and andesite-basalt lava flows. A common magmatic derivation for the gold and enclosing volcanic rocks is advocated.—M.S.T.

10860 **Gordon, R. B.** Thermally activated processes in the Earth—Creep and seismic attenuation—Contract ONR 609(54), Tech. Rept. 2: New Haven, Conn., Yale Univ. Dept. Eng. and Appl. Sci., 19 p., illus., 1966.

Non-elastic behavior of crystalline material results from thermally activated motion of crystal imperfections. The mobility of a crystal imperfection depends on depth in the Earth, increasing rapidly at first due to steep thermal gradient and then decreasing due to effect of pressure. Thermally activated movement of imperfections controls diffusion, phase transformation kinetics, high temperature creep, recrystallization, and damping of elastic waves in solid mantle material. Diffusion creep produces viscous flow at geologically significant rates in a polycrystalline solid. The resulting viscosity of the mantle passes through a minimum and is strongly depth dependent. Depth dependence of the damping of elastic waves is also found, but viscosity cannot be deduced from observed internal friction.—G.D.C.

**Gordy, P. L.** *See* Bally, A. W. 10716

10846 **Graf, Walter H.; Acaroglu, Ertan R.** Settling velocities of natural grains: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 4, p. 27–43, illus., tables, 1966.

In the investigation of sediment transport, an important detail is not only the grain size diameter itself, but the rate of fall of the particles through water. Natural sediment grains are usually odd-shaped; available knowledge on spherical particles does not always give the most accurate information on natural grains. Research done on these is discussed, and various drag equations and drag coefficients are tabulated and compared. With odd shaped particles, the drag coefficient is also dependent on the shape.—G.D.C.

10684 **Graham, John W.** Significance of magnetic anisotropy in Appalachian sedimentary rocks, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 627–648, illus., 1966.

Magnetic susceptibility anisotropy of over 400 oriented specimens of Paleozoic rocks from various structural settings was measured with a new instrument. General ellipsoids give good representation of the anisotropy of the majority of samples. Flat-lying undeformed sedimentary rocks have their minimum susceptibility axes normal to the bedding; the maximums are broadly dispersed in the bedding plane as a result of bottom currents. In contrast, the susceptibility ellipsoids in the Valley and Ridge province have conspicuous systematic relationships with structural setting. These are interpreted as resulting from flow orientation during a stage of plastic deformation. It is inferred that this zone of the Appalachians had a two-stage deformation, first homogeneous lateral shortening parallel to bedding planes, with gravity sliding as the favored mechanism, then folding.—*from* Author's abstract

00865 **Graham, R. S.** Barbed drainage pattern of the Salmon River, Tug Hill Plateau, New York [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 90–91, 1967.

00725 **Granquist, W. T.; Pollack, S. S.** Clay mineral synthesis—[Pt.] 2, A randomly interstratified aluminian montmorillonoid: Am. Mineralogist, v. 52, nos. 1–2, p. 212–226, illus., tables, 1967.

A randomly interstratified montmorillonoid was synthesized from a starting slurry of diatomite and bayerite in an aqueous solution of NaOH. The synthesis was carried out at 300°C and the corresponding $p_{water}$. Samples quenched at various reaction times were subjected to X-ray diffraction, DTA, surface area and cation exchange capacity determinations, and infrared absorption studies with particular emphasis on the 400–900 $cm^{-1}$ region. The synthesis-process is made up of several steps: solution of the solid reactants, nucleation of the layer lattice, and growth of these nuclei to the final crystalline product. The solution and/or nucleation steps are rate controlling.—*from* Authors' abstract

**Grant, Willard H.** *See* Centini, Barry A. 00744

**Green, D. H.** *See* Ringwood, A. E. 10682

10787 **Green, D. H.** The origin of the "eclogites" from Salt Lake Crater, Hawaii: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 414–420, tables, 1966.

The chemistry and petrography of garnet pyroxenite inclusions in olivine nephelinite tuff at Salt Lake Crater, Hawaii, are examined in relation to recent experimental studies of melting and subsolidus relations in basaltic rocks at high pressure. It is concluded that the rocks originated as accumulates of liquidus or near liquidus sub calcic clinopyroxene derived from alkali olivine basalt or basanite at 13–18 kb pressure. The accumulates cooled from 1350°–1400°C to about 1000°C at constant pressure causing exsolution of garnet from the highly aluminous pyroxene and reaction of spinel and pyroxenes to yield garnet and olivine. P, T conditions of initial accumulation and later recrystallization of garnet pyroxenites diverge widely from those responsible for formation of natural eclogites in metamorphic terranes or as inclusions in kimberlite pipes.—*from* Author's abstract

00783 **Greenman, Norman N.; Burkig, Valerie W.; Young, J. Fred.** Ultraviolet reflectance measurements of possible lunar silicates: Jour. Geophys. Research, v. 72, no. 4, p. 1355–1359, illus., table, 1967.

The reflectance of granitic, gabbroic, and serpentinitic rocks in the 2,000- to 3,000-A range has been measured to determine whether they display characteristic spectrums that could give compositional information about the lunar surface. Two separate sets of measurements were made on both solid and granular samples (three different grain sizes). In all cases the reflectance was found to decline gradually from 3,000 to 2,500 A and still more gradually from 2,500 to 2,000 A. Gabbroic samples showed highest reflectance values, with granitic samples nearly the same and serpentinite values lower for the most part. Little or no consistent variation with grain size was detected.—D.B.V.

00655 **Griffin, Leland R.** *Actinocoelia maeandrina* Finks, from the Kaibab Limestone of northern Arizona: Brigham Young Univ. Geology Studies, v. 13, p. 105–108, illus., 1966 [1967].

Numerous sponges of the species, *Actinocoelia maeandrina* Finks, are found in cherty concretions of the Beta Member of the Kaibab Limestone. They were collected from eight sections in an east–west traverse, from the Kaibab Plateau on the east, to near Las Vegas on the west. Although the sponges are numerous and occur over a wide area, only one species was found in the member. Associated fossils include brachiopods, pelecypods, crinoid stems, corals and bryozoa.—Author's abstract

10760 **Griscom, Andrew.** Magnetic data and regional structure in northern California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 407–417, illus., 1966.

This paper is a preliminary report on the aeromagnetic data available for northern California along with some discussion and interpretation of anomalies present. Areas covered include the Coast Ranges and continental margin, the Great Valley, the Sierra Nevada, and the Great Basin.—M.S.T.

00626 **Gunn, Christopher B.** The origin of diamonds in drift of the north central United States—A discussion [of paper by H. P. Schwarcz, 1965]: Jour. Geology, v. 75, no. 2, p. 232–233, 1967.

The hypothesis of H. P. Schwarcz (ibid., v. 73, p. 657–663, 1965) that meteor impact at Hudson Bay caused eruption of kimberlite, and that the diamonds in the glacial drift in the north central United States were derived from such kimberlites is questioned. Two occurrences of kimberlite in Quebec are cited, and so unknown sources for diamonds under Hudson Day need not be inferred. Also, Schwarcz' glacial transport pattern is that of late Wisconsin time, during recession; the pattern of earlier glaciations, when the diamonds were deposited, is not known.—F.B.

00794 **Gustafson, J. K.** Some thoughts on the Society of Economic Geologists: Econ. Geology, v. 62, no. 2, p. 171–185, 1967.

This presidential address considers that the principal impediments to growth and development of the Society are the separate status of the Society and the journal, "Economic Geology," and limited finances. Advances in geochemistry and geophysics as applied to economic geology and increasing participation of members in overseas developments offer challenges and opportunities.—W.S.W.

00677 **Gutschick, R. C.; Rodriquez, Joaquin.** Brachiopod zonation and correlation of Sappington Formation of western Montana: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 4, p. 601–607, illus., 1967.

The Sappington Formation (Devonian–Mississippian) of western Montana has been divided into nine informal stratigraphic units on the basis of brachiopod, foraminifer, and conodont faunas. Brachiopods occur in seven of the nine informal units, all but the lowest two. Correlation of parts of the Sappington with all or parts of the Louisiana Limestone and Hannibal Shale of Missouri, lower Banff Formation and Exshaw Shale of Alberta, and Leatham Formation of Utah is supported by brachiopods and foraminifers. Conodonts from the lower and upper Sappington and underlying and overlying formations helped to establish Devonian–Mississippian relations. *Tylothyris clarksvillensis*, an early Mississippian index brachiopod was first located in the Sappington Formation by the authors.—E.A.M.

**Gyenge, M.** *See* Coates, D. F. 10840

10748 **Hackel, Otto.** Summary of the geology of the Great Valley, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 217–238, illus., 1966.

The Great Valley is a large elongate northwest trending asymmetric structural trough filled with a very thick sequence of Jurassic to Recent sediments. This geosyncline has a long stable eastern shelf supported by the subsurface continuation of the granitic Sierran slope and a short western flank expressed by the upturned edges of the basin sediments. The basin has a regional southward tilt, interrupted by two significant cross valley faults. The northern fault, the Stockton, is the boundary generally used to separate the Great Valley Basin into the Sacramento and San Joaquin sub-basins. The other cross fault, the White Wolf, lies near the southern extremity of the basin.—M.S.T.

**Hagner, A. F.** *See* Fenner, P. 00704

00870 **Halbouty, Michel T.** Needed—Exploration ingenuity in geological and geophysical coordination: Geophysics, v. 32, no. 1, p. 12–16, 1967.

The big petroleum reserves of the future lie in the less obvious traps such as paleogeomorphic or stratigraphic, which geophysicists alone cannot identify. To find them, geophysical instruments will have to supplement geological thinking, not supplant it as was permitted for the past three decades. As geology is basically an inexact science, a good exploration geologist has to be an artist, working with knowns and unknowns, mixing together ideas and suppositions and facts.—D.B.V.

10699 **Hales, A. L.; Asada, T.** Crustal structure in coastal Alaska, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon 10 (Natl. Acad. Sci.—Natl. Research Council Pub. 1467), p. 420–432, illus., tables, 1966.

Observations of the 1955 explosions in College Fiord and Skagway, Alaska, have been reexamined in some detail. The differences in traveltimes for various azimuths show that the structure varies rapidly in many of the areas studied. From the College Fiord shots, the crust to the northeast is 48–53 km thick for several different interpretations, but southwest of College Fiord (in the region of the Kenai Peninsula) it is 10–15 km thinner. Northwest of Skagway the depth to the M discontinuity is 36–42 km, but north of Skagway it is only 35 km. Velocities within the crust range from 5.7 to 6.7 kmps, the generally higher velocities being found in the lower

part of the crust. The total mass of the columns to 60-km depth has been calculated with densities derived from the Nafe-Drake curves. The values are in satisfactory agreement with the standard section of Worzel and Shurbet.—Authors' abstract

10677 **Hales, Anton L.; Nation, Joseph B.** Reflections at the M discontinuity and the origin of microseisms, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 529–537, illus., 1966.

Reflected refractions observed on a deep-sea seismic profile in the Yucatán Basin are described. Similar phases were observed on seismic records recorded on land from shots fired in the deep sea during the East Coast Onshore Offshore Experiment. The conditions under which these phases arise are discussed. Theories of the origin of microseisms, especially that of Press and Ewing, are discussed. It is shown that, taking account of reflections at the M discontinuity, a very large proportion (more than 90 percent) of the seismic energy generated at the air-sea interface is trapped within the crust.—*from* Authors' abstract

**Hallock, H. B.** *See* Egan, W. G. 10885

00930 **Hallof, P. G.** The use of induced polarization method to find ore under Lake Chibougamau: Canadian Mining and Metall. Bull., v. 60, no. 661, p. 575–579, 1967.

The exploration staff of Campbell Chibougamau Mines Limited has used past experience to delineate several areas of geologic interest under Lake Chibougamau. During the winter of 1964–65, a reconnaissance induced polarization survey was carried out on the lake. First, several lines were surveyed over the known mineralization at the Henderson mine; the grid was then extended into the areas of interest. Several anomalous zones were located and drilled; one of these proved to be of economic interest.—Author's abstract

00928 **Halls, C.; Clark, A. M.; Stumpfl, E. F.** Some observations on silver-antimony phases from Silverfields mine, Ontario, Canada: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 723, p. B19–B24, illus., table, 1967.

Electron-probe analyses of naturally occurring silver-antimony phases from Silverfields mine, Cobalt, Ontario show that dyscrasite does not occur and that the three optically homogeneous phases recognized by previous workers are confined to the composition range between Ag$_{0.8}$Sb and $\alpha$-silver containing a few wt percent Sb in solid solution. Published synthetic phase equilibrium data for the system Ag-Sb at and above 300°C contain only two stable phases in this composition range. Phases described from Silverfields contain up to 8 wt percent Hg and comparison with synthetic data in the binary system Ag-Sb can be only approximate. Concentrations of mercury are considered a potential source of mercury dispersion aureoles in host rocks and soils.—*from* Authors abstract

10689 **Halls, H. C.** A review of the Keweenawan geology of the Lake Superior region, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 3–27, illus., 1966.

Precambrian Keweenawan sediments and volcanics form a large structural basin known as the Lake Superior syncline, which seems to connect at its western end with a narrow trough of Keweenawan rocks extending from the central United States and only emerging from beneath a cover of younger sediments in the Lake Superior region. The Lake Superior syncline thus forms part of a major tectonic feature of North America. During a single episode of volcanism and subsequent intrusion, an enormous quantity of basic rocks was produced during an early stage of the syncline's evolution. Volcanism was punctuated by short pauses permitting formation of thin interflow sediments. During the latter part of Keweenawan time the syncline continued to subside after cessation of volcanic activity, forming a basin of deposition in which a thick sequence of sandstones and conglomerates accumulated.—*from* Author's abstract

**Hamblin, W. K.** *See* Best, Myron G. 00654

**Hamilton, Douglas H.** *See* Fett, John D. 00929

10803 **Hamilton, Warren.** Origin of the volcanic rocks of eugeosynclines and island arcs, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 348-355, illus., 1966.

Volcanic rocks which characterize eugeosynclines now parts of continents are dominantly tholeiitic basalts or andesite, dacite, and high-alumina basalt. Either type can occur upon crust previously oceanic or continental. The ocean floor along the continental margin is the modern analog of the oceanic tholeiitic eugeosyncline, the island arc of the oceanic andesitic eugeosyncline. High-pressure laboratory data suggest that high-alumina basalt was probably equilibrated with crystals at depths shallower and tholeiite at depths deeper than the eclogite transformation. Andesitic magmas may represent varying degrees of melting of the basaltic component of the mantle at levels shallower than the eclogite transformation, and tholeiite magmas more complete melting of the basaltic component beneath that boundary. Assimilation by zone refining may have modified initially basaltic magmas to produce more silicic magmas.—*from* Author's abstract

10816 **Hamilton, Warren.** Formation of the Scotia and Caribbean arcs, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 178-185, illus., 1966.

Continental connections existed between North and South America and between South America and Antarctica at the beginning of Tertiary time, and probably consisted of narrow Mesozoic eugeosynclinal belts whose fragments now form the larger islands of the Caribbean and Scotia arcs. If the continents are regarded as having drifted westward into the Pacific Ocean basin, then the two arcs can be pictured as formed by the disruption of the narrow bridges, which lagged behind the continents.—Author's abstract

10926 **Hammond, Edwin H.** (compiler). Classes of land-surface form in the United States—National Atlas of the U.S., Sheet 64-61: Washington, D. C., U.S. Geol. Survey, 1 sheet, text, 1966.

The sheet contains a map showing the physical subdivisions of the United States (scale 1:17,000,000) with insets of Alaska (scale 1:38,500,000) and Hawaii (scale 1:17,000,000), and a map showing classes of land-surface form in Alaska (scale 1:7,500,000).—M.C.M.

**Hampton, E. R.** *See* Lystrom, D. J. 00822

**Handin, John.** *See* Borg, Iris. 00698

00699 **Handin, John; Heard, H. C.; Magouirk, J. N.** Effects of the intermediate principal stress on the failure of limestone, dolomite, and glass at different temperatures and strain rates: Jour. Geophys. Research, v. 72, no. 2, p. 611-640, illus., tables, 1967.

The effect of the intermediate principal stress, $sigma_2$, is an important unresolved problem in failure theory. In this work an advantage of the torsion test has been exploited (that all three principal stresses can be made to differ from one another) in an attempt to develop a quantitative macroscopic failure criterion that could adequately account for all three principal stresses. While this was not achieved, several significant observations were made and are reported here.—D.B.V.

00673 **Hanna, William F.** Paleomagnetism of Upper Cretaceous volcanic rocks of southwestern Montana: Jour. Geophys. Research, v. 72, no. 2, p. 595-610, illus., tables, 1967.

Results of paleomagnetic studies of folded and flat-lying volcanic rocks in southwestern Montana are reported. After partial demagnetization both normal

and reversed magnetizations are found and a field polarity sequence tentatively established in connection with Late Cretaceous and early Tertiary orogenic events. The geomagnetic pole calculated for the Elkhorn Mountains Volcanics, 69° N., 171° W., agrees generally with Late Cretaceous poles for North America, Madagascar, and the U.S.S.R. but differs significantly from Early Cretaceous poles of Japan and Australia.—D.B.V.

00769 **Hanneman, R. E.; Strong, H. M.; Bundy, F. P.** Hexagonal diamonds in meteorites—Implications: Science, v. 155, no. 3765, p. 995–997, illus., table, 1967.

A new polymorph of carbon, hexagonal diamond, has been discovered in the Canyon Diablo and Goalpara meteorites. This phase had been synthesized recently under specific high-pressure conditions in the laboratory. Our results provide strong evidence that diamonds found in these meteorites were produced by intense shock pressures acting on crystalline graphite inclusions present within the meteorite before impact, rather than by disintegration of larger, statically grown diamonds, as some theories propose.—Authors' abstract

00743 **Hanson, H. S.** Origin of inclusions in the Leatherwood Quartz Diorite, Santa Catalina Mountains, Pima County, Arizona [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 87, 1967.

**Harbaugh, John W.** *See* Smith, John W. 10856

00736 **Hardie, Lawrence A.** The gypsum–anhydrite equilibrium at one atmosphere pressure: Am. Mineralogist, v. 52, nos. 1–2, p. 171–200, illus., tables, 1967.

The equilibrium temperature for the reaction gypsum = anhydrite + $2H_2O$ (liq. soln.) has been determined as a function of activity of $H_2O$ of the solution. The equilibrium, approached from both sides, is defined by: $a_{water} = 0.960$ at 55°, 0.845 at 39°, 0.770 at 23°C. Provided the solids do not change in composition, the equilibrium at constant P and T depends on $a_{water}$ only. Extrapolation to the bounding system $CaSO_4$–$H_2O$ ($a_{water} = 1.000$) yields 58° ± 2°C, within thermodynamic calculations (46° ± 22°). The data indicate that in sea water saturated with halite, gypsum should dehydrate about 18°C, compatible with the finding of anhydrite in Recent supratidal flat sediments of the Trucial Coast, Persian Gulf.—E.Z.

**Harper, Delbert D.** *See* Swingle, George D. 00938

**Harris, William L.** *See* Silverman, Arnold J. 00853

00818 **Harriss, Robert C.** Silica and chloride in interstitial waters of river and lake sediments: Limnology and Oceanography, v. 12, no. 1, p. 9–12, table, 1967.

Interstitial waters of sediments from the Concord River, Mass., Neuse River, N. C., and Seneca Lake, N. Y., have higher concentrations of dissolved silica and chloride, and lower *p*H values than coexisting surface waters in equilibrium with the atmosphere. The highest silica concentrations in the interstitial waters (20–50 mg/liter greater than coexisting river water) are observed in organic bog sediments and in river sediments at depths of 6 cm or more below the sediment–water interface. The high silica and low *p*H values appear to be primarily a result of the decomposition of organic matter. The high chloride concentrations are attributed to evaporation of rain water solutions in the soil.—Author's abstract

10749 **Hart, Earl W.** Economic mineral deposits of the Great Valley, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 249–252, illus., tables, 1966.

The mineral deposits of the Great Valley yield about one-third of the State's mineral production. Petroleum, natural gas and natural-gas liquids constitute 90 percent of production, and sand and gravel make up nearly nine percent. Nearly all of the petroleum and a large quantity of "wet" natural gas are produced from fields of the San Joaquin Valley. "Dry" natural gas, however, comes mainly from gas reservoirs in the Sacramento Valley and northern San Joaquin Valley. Some gold

is produced by dredging placers where major streams enter the Great Valley. Other minerals being produced in minor quantities are clay, gypsum, peat, coal, pumicite, crushed stone, and some gemstones.—M.S.T.

**Hart, Stanley R.** *See* Steiger, Rudolf H. 00731

10674 **Hart, Stanley R.; Tilton, George R.** The isotope geochemistry of strontium and lead in Lake Superior sediments and water. *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci. Natl. Research Council Pub. 1467), p. 127–137, illus., tables, 1966.

Concentrations of K, Rb, and Sr in eight samples of gray clay sediment average 3.4 percent, 160 ppm, and 190 ppm, respectively. These concentrations vary less than ±15 percent over sediment depths of four meters and an areal extent of 400 km. The isotopic composition of Sr in the sediment is also constant, with a Sr-87 to Sr-86 value of 0.739. Analysis of two samples of deep lake water showed that the water Sr is not in isotopic equilibrium with sediment Sr. Results of the isotopic analysis of three fractions of lead from one sediment sample indicate that the lake sediments were derived dominantly from the 2.5–3.0 b.y. rocks of the Superior Province shield. The Sr results are consistent with the following average values for the source rock—Sr 87 to Sr 86 = 0.730 ± 0.01, Rb/Sr = 0.25 ± 0.10. *from* Authors' abstract

**Hartshorn, J. H.** *See* Koteff, Carl. 00829

**Hartsock, John K.** *See* Detterman, Robert L. 00648

00718 **Hauser, V. L.; Lotspeich, F. B.** Artificial groundwater recharge through wells: Jour. Soil and Water Conserv., v. 22, no. 1, p. 11–15, illus., tables, 1967.

Artificial ground-water recharge through wells using local surface runoff appeared to be the most effective means for recharging the Ogallala Formation of the Southern High Plains. Suspended solids in raw playa lake water clogged the formation near recharge wells. A field recharge system effectively removed more than 90 percent of the suspended solids by flocculation and settling after treatment by a cationic polyelectrolyte and alum. Both recharge and native ground water contained only small amounts of salts and nitrates and were suitable for irrigation and other uses. Data showed that ground-water recharge is not likely to pollute an aquifer more than a few feet from a recharge well.—*from* Authors' summary

**Hax, Arnoldo.** *See* Lomnitz, Cinna. 10686

**Hays, William H.** *See* Rogers, William B. 00830

10855 **Hazen, Scott W., Jr.; Meyer, William L.** Investigation of correlation between assay values and unequal sample interval lengths: U.S. Bur. Mines Rept. Inv. 6867, 46 p., illus., tables, 1966.

Unequal channel or core sample lengths usually result when separate assays of high and low-grade ore are desired. Average grade is then commonly determined by weighting the assays according to the volume they represent. Many ores exhibit correlation between sample length and grade, that is, long samples representing the thickest portions are the highest or lowest grade. An apparent linear relation exists between the degree of correlation present and the difference between weighted and unweighted average grade. This relation is explored by computer simulation, and by reference to actual assay data. The inherent difference in variance between high and low grade should be determined, and the number of samples or sample volume adjusted to achieve the desired overall level of precision.—K.F.F.

**Heard, H. C.** *See* Handin, John. 00699

00687 **Hedge, Carl E.; Peterman, Zell E.; Braddock, W. A.** Age of the major Precambrian regional metamorphism in the northern Front Range, Colorado: Geol. Soc. America Bull., v. 78, no. 4, p. 551–557, illus., table, 1967.

Rubidium–strontium dating of nine whole-rock samples indicates that major regional metamorphism occurred 1.75±0.03 b.y. ago. Samples of seven syntectonic and late tectonic igneous rocks give a concordant age of 1.71±0.07 b.y.—A.G.

**Heezen, Bruce C.** *See* Conolly, J. R. 00631

**Heezen, Bruce C.** *See* Ninkovich, Dragoslav. 10789

00750 **Heising, L. F.; Frommer, D. W.** Lake Superior iron resources—Preliminary samples and metallurgical evaluation of selected Michigan–Wisconsin iron formations: U.S. Bur. Mines Rept. Inv. 6895, 31 p., illus., tables, 1967.

Beneficiation of low-grade iron ores from the Gogebic, Menominee, and Marquette Ranges was attempted by reductive roasting–magnetic separation and flotation. The nonmagnetic Gogebic ores were represented by trench and drill-core samples of all five members of the Ironwood Formation. The concentrates were judged unacceptable by present standards. The Menominee Range ores were represented by a sample from both the Curry Member and the Traders Member of the Vulcan Iron Formation. Both samples produced acceptable concentrates. The Marquette Range samples were mostly of the extensive but low-grade hematitic–goethitic–martitic jaspers. Acceptable concentrates were obtained from some of the samples. Petrographic descriptions of the samples are listed in an appendix.—K.F.F.

**Helsley, C. E.** *See* Stehli, F. G. 00693

10896 **Hendron, A. J., Jr.** Discussion [of "Laboratory testing of rock strength," by B. B. Mazanti and G. F. Sowers, 1966], *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 228–229, illus., tables, 1966.

This discussion questions some of the assumptions (Mazanti and Sowers, ibid., p. 207–227) underlying experiments used to calculate rock strengths. A reply to this discussion by the original authors is given on p. 230–231 (ibid.).—M.S.T.

**Hendron, A. J., Jr.** *See* Deere, D. U. 10905

10918 **Herrmann, H. G.; Wolfskill, L. A.** Engineering properties of nuclear craters—Rept. 5, Residual shear strength of weak shales: U.S. Army Corps Engineers Waterways Expt. Sta. Tech. Rept. 3-699, 203 p., illus., table, 1966.

Laboratory determination of the residual shear strength of weak shales, such as those within the Panama Canal Zone, is proposed mainly as an index of the potential for shales or deeply weathered rocks to lose substantial strength with time. Residual shear strength, a constant for any given soil regardless of stress history, is the lowest "ultimate" strength; laboratory measurements can vary simply because of failure to reach this lowest strength. In an effort to develop equipment and testing procedures for its reliable measurement, the direct shear test, with about 30 repeated loadings on mechanically disintegrated and resedimented samples, resulted in an inadequate index property test. Results are given for two Canal Zone shales, Pierre Shale from South Dakota, and a kaolinitic clay.—G.D.C.

10798 **Hersey, J. B.** Marine geophysical investigations in the West Indies, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 151–164, illus., 1966.

Early seismic refraction studies between Nares Deep and northeastern South America have shown that the Deep and outer ridge have a thin crustal layer and structures of typical ocean basins. The Caribbean Sea has a thicker crust consisting of a 6.0–6.7 kmps shallow layer and a 7.0–7.5 kmps deeper one. The crustal layer deepens and is overlain by lower velocity sediments in the Greater and Lesser Antilles and the foredeep. Seismic reflection profiles after 1960 over Nares Deep, outer ridge, and Puerto Rico trench reveal in detail these low velocity layers and show two contrasting bodies of sediments that lie unconformably on a surface of high relief which corresponds to the top of a 5.2–5.5 kmps layer. The shallowest group of sediments, Oligocene, can be traced to where it underlies flat lying

sediments in the deepest part of the trench. It may be a remnant of a continental rise.—*from* Author's abstract

10790 **Hess, H. H.** Caribbean research project, 1965, and bathymetric chart, *in* Caribbean geological investigations: Geol. Soc. America Mem. 98, p. 1–10, illus., 1966.

The Caribbean project of the Department of Geology at Princeton University includes the whole province and is to continue over a long span of years. Major interests are the structural development of an island arc area and relationship of its current volcanism and seismicity. The belt of gravity anomalies curving from the Puerto Rico Trench around the Lesser Antilles arc is out of isostatic equilibrium. Ultramafic bodies, once considered serpentinized peridotite intrusions, appear now to represent mantle rocks that reached the surface as solids. Apparently simple structures are often deceptive; gravity sliding occurs commonly on a large scale; metamorphism is related to increase in geothermal gradient rather than to dynamic effects. The accompanying bathymetric chart, much revised since 1939, now includes the Barracuda fault zone.—G.D.C.

**Hewett, D. F.** *See* Radtke, Arthur S. 00792

00850 **Hewitt, D. F.; Watt, A. K.** Industrial mineral resources, Brampton area, west sheet, southern Ontario: Ontario Dept. Mines Prelim. Geol. Map P. 413, scale 1:50,000, 1967.

The map sheet includes a list of industrial mineral properties, active and inactive (brick plants, sandstone quarries, dolomite quarries, sand and gravel).—M.C.M.

00851 **Hewitt, D. F.; Watt, A. K.** Industrial mineral resources, Brampton area, east sheet, southern Ontario: Ontario Dept. Mines Prelim. Geol. Map P. 414, scale 1:50,000, 1967.

The map sheet includes a list of industrial mineral properties, active and inactive (brick plants, sandstone and dolomite quarries, and sand and gravel).—M.C.M.

00740 **Hickman, R. C.; Lynch, V. J.** Chattanooga Shale investigations: U.S. Bur. Mines Rept. Inv. 6932, 55 p., illus., tables, 1967.

Uranium content of the Chattanooga Shale in central Tennessee averages 0.006 percent, based on analysis of core from 72 drill holes aggregating about 12,000 feet, and including samples from outcrop and an exploratory adit. The uranium content is too low to permit economic recovery at present, but constitutes a potential resource.—K.F.F.

00634 **Hietanen, Anna.** On the facies series in various types of metamorphism: Jour. Geology, v. 75, no. 2, p. 187–214, illus., 1967.

Metamorphic facies, subfacies, and zones are discussed with reference to a hypothetical P–T diagram whose focus is the andalusite–kyanite–sillimanite triple point. The position of the triple point, about 500°C and 5 kb, was chosen to satisfy the author's interpretation of relations shown by metamorphic rocks northwest of the Idaho batholith. Metamorphic types discussed are: contact, Japanese, Buchan, Pyreneean, Michigan, Idaho, Northwest Highlands (Barrovian), Saxonian, Alpine, zeolitic, and retrograde. Other topics discussed are: the stability field of cordierite, the use of $Al_2SiO_5$ polymorphs as geologic barometers, and the value of compositional data on coexisting metamorphic minerals. One hundred sixty five references are listed.—B.F.L.

10685 **Hill, D. P.; Pakiser, L. C.** Crustal structure between the Nevada Test Site and Boise, Idaho, from seismic refraction measurements, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 391–419, illus., tables, 1966.

In 1962 reversed seismic-refraction profiles were established between Eureka, Nev., and Boise, Idaho, and additional recordings of nuclear events at the Test Site were made. Interpretation of refracted and reflected P-events indicates: crust in the northern Basin and Range province consists of a 6.0-kmps layer 19 to 24 km thick above a 6.7-kmps layer 10 to 12 km thick; both the whole crust and the 6.7-kmps layer thicken abruptly at the Basin and Range province-Snake River Plain boundary; the 6.0-kmps layer thins across this boundary and may be absent under the Plain; crust in the western Plain consists of a 5.2-kmps layer 8 to 10 km thick above a 6.7-kmps layer 33 to 38 km thick; upper mantle under both provinces has a P-velocity of about 7.9 kmps, and consists of highly absorptive material or contains a low-velocity layer immediately below the M-discontinuity.—*from* Authors' abstract

**Hill, D. P.** *See* Decker, R. W. 10866

**Hines, Marion S.** *See* Plebuch, Raymond O. 00932

00776 **Hodge, Paul W.; Wright, Frances W.; Langway, Chester C., Jr.** Studies of particles for extraterrestrial origin—[Pt.] 5, Compositions of the interiors of spherules from Arctic and Antarctic ice deposits: Jour. Geophys. Research, v. 72, no. 4, p. 1403–1406, illus., tables, 1967.

Previous papers in this series reported the results of electron microprobe analysis of the surfaces of microscopic particles of several origins, some of which are possibly extraterrestrial in origin (1963, –64, –65). This paper presents results of similar analysis of the sectioned and polished interiors of some of these particles. Contrary to expectations, there was seldom any significant difference between the surface and the interior. The particles analyzed are rather homogeneous in composition; the Fe-rich particles do not generally have Ni concentrated toward their centers, as do some deep-sea spherules. Two New Mexico spherules and one Sikhote-Alin meteorite spherule are similarly homogeneous.—D.B.V.

**Hodges, Arthur L., Jr.** *See* Cederstrom, D. J. 00905

10775 **Hodgson, John H.** Seismology and earthquake engineering: Impact of Science on Society, v. 16, no. 4, p. 297–320, 1966.

In the quarter-century between 1926 and 1950 more than 350,000 people were killed by earthquakes and damage to engineering structures totaled nearly 10,000 million dollars. The problems of earthquake resistant design of structures are intensified by the fact that for the most part the countries with the greatest earthquake risks have the least technical competence to meet them. A brief review of the field of seismology is given to demonstrate that seismologists and geologists now have the ability to define areas of seismic risk precisely and that engineers can design most structures to resist earthquakes. It is concluded that UNESCO should bring the benefits of this knowledge to those countries where much of the earthquake loss occurs.—V.S.N.

10865 **Hoffer, A.** Seismic control of layering in intrusives: Bull. Volcanol., v. 29, p. 817–821, 1966.

The intermittent occurrence of earth tremors during the solidification of magma is considered a possible mechanism for the development of layering in intrusives. Qualitatively, at least, the effect is comparable to that of shocks being administered to supersaturated liquids in the laboratory. It should be possible to interpret the seismic history of the region during the crystallization of the intrusive from a critical and detailed analysis of the pattern of layering developed. Convection currents, on the other hand, are unlikely to play a significant role in the development of layering, because the dimensions and the distribution of convection cells are rigorously controlled by the depth of the liquid, which changes continuously as crystallization progresses.—Author's abstract

00752 **Hofmann, H. J.** Precambrian fossils(?) near Elliot Lake, Ontario: Science, v. 156, no. 3774, p. 500–504, illus., table, 1967.

Complex structures in Upper Huronian (Lower Proterozoic) quartzite north of Lake Huron are interpreted as probable metazoan fossils aged between 2 and 2.5 b.y. They are preserved as sand casts in the form of curved spindles having inclined lateral corrugations, axial markings, and apparent bilateral symmetry.—Author's abstract

10888 **Holdsworth, D. W.; Barringer, A. R.** Studies of the radar properties of rocks in vacuum and the design of a specialized radar for measuring stratification features of the lunar and terrestrial surface, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 475–487, illus., tables, 1966.

Experiments using VHF radar techniques to detect and map subsurface discontinuities such as soil layering, rock interfaces, and ore deposits in the lunar surface are described. Loss tangents, dielectric constants, and reflectivities of various natural and synthetic silicate materials were measured under extremely dry and vacuum dried conditions. Results indicate vacuum conditions and frequency of incident radiation are critically important in behavior of this radar system. A layered surface was simulated with fine and coarse pumice and examined at 300 mcs. For a 6 m layer case the energy reflected from the lower interface and emitted from the surface is 12 db down on the energy reflected from point of impingement of the direct wave. From these experiments a substantial case exists for sounding the lunar surface in the same manner as polar ice caps. The radar system is illustrated and described.—B.S.H.

**Holt, Richard J.** *See* Murphy, Vincent J. 10921

00780 **Hood, P. J.; Sangster, D. F.** The Carey Foster in situ susceptibility meter: Canada Geol. Survey Paper 65–22, 17 p., illus., 1967.

Most susceptibility meters are designed for study of hand specimens, which may not be representative of a given formation. A susceptibility meter is described here which permits direct measurements at the outcrop; it uses a Carey Foster bridge. Field results from a geophysical study of the Briarcliffe Lake magnetite deposit in the Kapiho Iron Range, Ontario, are presented, together with results of calibration of the instrument using mixtures of sand and magnetite. The in-situ susceptibility meter is more reliable for delineation of the highest tenor zones of magnetite iron-formation than the magnetometer because of the presence of remanent magnetism.—G.D.C.

10739 **Hood, Peter.** Magnetic surveys of the continental shelves of eastern Canada, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–15, p. 19–32, illus., 1966.

Sea and airborne magnetometer results are presented for parts of the Scotia Shelf, Grand Banks of Newfoundland, and Flemish Cap. A circular magnetic low surrounded by magnetic highs south of Halifax, is probably produced by a Devonian granite. Relatively flat magnetic contours extend east and south from Chedabucto Bay in an area where a negative free-air gravity anomaly ("Orpheus" anomaly) has been reported; a substantial thickness of underlying sediments is indicated. Isolated magnetic anomalies parallel the edge of the continental shelf along the southwestern Grand Banks. Depth determinations indicate a cover over the magnetic basement between 14,000 and 19,000 feet thick. A series of sharp shallow-source anomalies was recorded over the Flemish Cap. This feature appears to have a negatively polarized core and may be of Mesozoic or later basaltic material.—*from* Author's abstract

**Hope, E. W.** *See* Kittrick, J. A. 00723

**Hope, E. W.** *See* Kittrick, J. A. 00729

10898 **Hoskins, J. R.** Discussion [of "A loading system for the investigation of the inelastic properties of geologic materials," by H. R. Hardy, Jr., 1966], *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965,

Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 266–270, 1966.

This is a discussion of various problems in rock mechanics the solutions to which may be found by use of the loading system described in the original paper (ibid., p. 232–265). A review of some recent studies of properties of materials is given also.—M.S.T.

00910 **Hounslow, A. W.; Moore, J. M., Jr.** Chemical petrology of Grenville schists near Fernleigh, Ontario: Jour. Petrology, v. 8, pt. 1, p. 1–28, illus., tables, 1967.

A suite of mica schists from the staurolite zone was studied in detail. Phase rule considerations and distribution relations indicate that chemical equilibrium was attained within the sample volume. Iron–magnesium ratios of the silicates vary greatly, and correlate with rock ferrous–ferric ratio, as does the oxide mineral mode. Rock oxidation state varies locally, and is probably dependent on the composition of the original sediment. Distribution coefficients for Fe, Mg, and Mn among garnet, biotite, and staurolite show no variation attributable to temperature. Partition of Fe and Mg between staurolite and biotite is regular, but non-ideal. The staurolite structure permits only limited (15–35 percent) substitution of Mg for Fe.—Authors' abstract

00813 **Howe, A. C. A.; Rowntree, T. C.** Geology and economic significance of the Bernic Lake pegmatite, Manitoba: Canadian Mining and Metall. Bull., v. 60, no. 658, p. 207–212, 1967.

The Bernic Lake pegmatite near Lac Du Bonnet in southern Manitoba is a complexly zoned pegmatite containing several lithium-bearing units in addition to the western world's largest known reserve of cesium. The pegmatite forms a flat-lying ellipsoidal body within an east-west-trending Precambrian amphibolite. The pegmatite enclosed by this vertically schistose amphibolite lies near the eastern tip of a granitic intrusive. The relation of this intrusive to the pegmatite is obscured by Bernic Lake. To date, the pegmatite body has been delineated over an area of approximately 80 acres; it attains a maximum thickness of 280 feet.—Authors' abstract

10693 **Howell, B. F., Jr.** Lake Superior seismic experiment—Frequency spectra and absorption, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 227–233, illus., 1966.

Fourier-integral frequency spectra were calculated for the range 4–26.8 cps for first arrivals in two distance ranges, 35–82 and 158–252 km. The short-range arrival is interpreted as a direct pulse, the second as a refracted (head-wave) pulse. The refracted pulse was weaker in energy above 8.8 cps than the direct pulse. This finding, similar to the filtering effect observed in the Maine seismic experiment, is explainable, using Nakamura's theory, by a transition layer 0.16 km thick. Absorption coefficient in the short range was found not to be significantly different from zero. For the greater distance range, absorption was larger but not significantly dependent on frequency and is too small to explain the difference in the frequency spectra.—*from* Author's abstract

**Huddle, John W.** *See* Englund, Kenneth J. 00650

10778 **Hülsemann, Jobst.** Spiralfährten und "geführte Mäander" auf den Meeresboden: Natur u. Mus., v. 96, no. 11, p. 449–455, illus., 1966.

Two stereoscopic pairs of photos show spiral markings in the ocean bottom sediments on the west side of the central valley of the Mid-Atlantic Ridge at depths of 3,400 and 3,600 m; the marks are 35–45 cm in diameter and the upraised bands are about 1 cm wide. After about four or five windings, the marks begin to follow a regular meander pattern for three 180° turns and then disappear. The source of the markings is unknown. Similar markings, which have been attributed to worms, snails, and enteropneustans, are noted briefly.—E.S.L.

10818 **Hunkins, Kenneth.** The Arctic continental shelf north of Alaska, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–15, p. 197–205, illus., 1966.

North of Alaska, the shelf ranges from a normal type off Point Barrow to a "continental borderland" type north of Chukchi Sea. Northwest of Barrow, seismic refraction results indicate a layer with a compressional-wave velocity of 7.4 kmps which rises from a depth of 32 km at Barrow to 20 km near the edge of the shelf. Cretaceous rocks of the Arctic coastal plain thicken seaward from 1.1 km at Barrow to 6 km near the edge of the shelf. Chukchi Cap is evidently a feature of continental origin north of the Chukchi Sea, although now separated from the shelf by a saddle; the Cap is 150 km in diameter at the 500-m contour. Shallowest sounding recorded for the Cap is 246 m; a continuous 1,000-gamma positive magnetic anomaly bordering its western and northern margins is interpreted as an effect of a buried basement ridge similar to that found along the continental margin of eastern North America.—*from* Author's abstract

00790 **Hunt, Charles B.** Physiography of the United States: San Francisco, Calif., and London, W. H. Freeman and Co., 480 p., illus., tables, 1967.

This book, an outgrowth of a course offered at The Johns Hopkins University for students not majoring in one of the earth sciences, deals with physical geography, geology, climate, soils, vegetation, resources and related phenomena in the natural regions of the United States. Their structural framework is outlined, surface deposits, weathering, erosion and sedimentation discussed. The regions, in addition to the physiographic provinces of the conterminous states, include Alaska, Hawaii, and Puerto Rico.—G.D.C.

**Hurley, P. M.** *See* Moorbath, S. 00795

10797 **Hurley, Robert J.** Geological studies of the West Indies, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–15, p. 139–150, illus., 1966.

Dredging and seismic reflection profiles show that Aves Ridge is at least partly volcanic in origin; vertical movements appear to have been slight and only one small and shallow guyot has been found. Reflection lines in the northern Lesser Antilles indicate that younger vulcanism has not migrated westward but was initiated on a line diverging westward from the original volcanic arc. Other reflection lines do not show the South Caribbean fault north of Trinidad but do show the Tertiary Bar sediments which outcrop in Barbados are more extensively distributed on Barbados Ridge. These sediments were derived from the north flank of an east-west trending Late Cretaceous mountain range in northern Trinidad but are separated from the central basin of Trinidad to the south. A relation may exist between filling of a trench and later compression and uplift.—*from* Author's abstract

00871 **Huxley, Thomas Henry; Eiseley, Loren.** (editor). On a piece of chalk: New York, Charles Scribner's Sons, 90 p., illus., 1967.

*On a piece of chalk* was first delivered in 1868 as a lecture to the working men of Norwich, England during a meeting of the British Association for the Advancement of Science. It reveals Huxley's natural gift of clear exposition linked with profundity—taking simple things and proceeding back into the mist of long-vanished geological eras. The tiny organisms of the chalk link one fauna to another: the story of the chalk reveals the continuity of the stream of life. An introduction and notes by the editor are added. Drawings illustrating the text are made by the modern artist, Rudolf Freund.—G.D.C.

00644 **Imlay, Ralph W.** The Mesozoic pelecypods *Otapiria* Marwick and *Lupherella* Imlay, new genus in the United States: U.S. Geol. Survey Prof. Paper 573 B, p. B1–B11, illus., tables, 1967.

Monotid pelecypod genera *Otapiria* Marwick and *Lupherella* Imlay n.gen., are recorded for the first time from Mesozoic beds in the United States. *Lupherella* is represented by *L. boechiformis* (Hyatt) from beds of Pliensbachian age in eastern

Oregon and California. *Otapiria tailleuri* Imlay, n.sp., has been found in northern Alaska associated with or directly underlying *Inoceramus cf. I. lucifer*, Eichwald, whose presence indicates an early Middle Jurassic or late Early Jurassic age. Another species of *Otapiria* has been found as float in the upper Yukon Valley in east-central Alaska. *Otapiria* has been found previously in Upper Triassic to Upper Jurassic beds in New Zealand, Lower Jurassic beds in New Caledonia, and Upper Triassic to Lower Jurassic beds in northeastern Siberia.—R.W.I.

**Inman, D. L.** *See* Bowen, A. J. 10777

10852 **Innes, M. J. S.; Weston, A. Argun.** Crustal uplift of the Canadian shield and its relation to the gravity field, *in* Internat. symposium on recent crustal movement, 2d, Aulanko, Finland, 1965, Proc.: Acad. Sci. Fennicae Annales, ser. A-III, no. 90, p. 169-176, illus., table, 1966.

Approximately 50,000 regional gravity stations have been observed at intervals of 8 to 12 km on systematic surveys in Canada since 1958. Free air and isostatic anomalies for an extensive area of the Precambrian Shield support the hypothesis that maximum crustal depression due to glacial loading was centered in Hudson Bay. Statistical analyses show a distinct decrease in gravity of about 26 milligals toward Hudson Bay which may reflect incomplete isostatic adjustment following deglaciation.—Authors' abstract

10765 **Irwin, William P.** Geology of the Klamath Mountains province, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 19-38, illus., table, 1966.

The area is divided into the eastern Klamath belt, central metamorphic belt, western Paleozoic and Triassic belt, and western Jurassic belt. It consists mainly of eugeosynclinal and plutonic rocks which were involved in the Nevadan orogeny, and are termed "subjacent." Younger "superjacent" rocks surrounding the Klamath Mountains are well-bedded Cretaceous marine sediments unconformably deposited on the subjacent rocks. These subjacent rocks, Ordovician to Late Jurassic in age, are distributed in concentric, rudely arcuate belts, emphasized by linear bodies of ultramafics, generally peridotite that tend to be concentrated along boundaries between the belts. Some granitic bodies, predominantly quartz diorite, also conform to the arcuate pattern, which is again emphasized by faults separating the belts, and fold axes generally paralleling the structure.—M.S.T.

**Ito, I.** *See* Sassa, K. 00805

10909 **Jackson, D. E.** Graptolitic facies of the Canadian Cordillera and Arctic Archipelago—A review: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 469-485, illus., 1966.

The Ordovician and Silurian series and subseries of Great Britain, Estonia, Sweden, Australia, and North America are reviewed in an attempt to select a time stratigraphic classification applicable to the Canadian graptolite sequence. Consideration is given to the boundaries between the Cambrian, Ordovician, Silurian, and Devonian Systems. With this background setting the author summarizes the present knowledge of the graptolitic rocks of the geosynclinal areas of British Columbia, Yukon Territory, and Northwest Territories. The graptolite succession is interrupted in parts of the area by an unconformity in the upper Middle Ordovician.—W.A.C.

**Jackson, D. E.** *See* Larson, M. L. 10916

**Jackson, W. H.** *See* Roller, J. C. 10695

00781 **Jaeger, R. R.; Lipschutz, M. E.** Pressure history of some iron meteorites: Nature, v. 213, no. 5080, p. 975-977, illus., table, 1967.

Comparisons with artificially shocked standards show that many iron meteorites have been shocked at pressures of at least 130 kilobars. These shocks probably

originated from preterrestrial collisions, rather than from impact with Earth. Authors' abstract

10671 **James, David E.; Steinhart, John S.** Structure beneath continents— A critical review of explosion studies 1960–1965, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 293–333, illus., 1966.

Significant results, techniques, and ideas emerging from explosion studies of the continental crust in Russia, Japan, Europe, and the United States are brought together and evaluated. It is concluded that uppermost mantle velocities vary as much as 10 percent, and crustal and weighted mean velocities vary significantly laterally, indicating that no simple direct relation exists between gravity anomalies, elevation, and crustal thickness. There is some indication that small velocity reversals may occur in the lower crust. Near-vertical reflections from discontinuities indicate more complex crustal structures than suggested by refraction. There is no agreement about the nature of intracrustal discontinuities, and future effort should be on comprehensive three-dimensional studies of velocity distributions in crust and upper mantle and investigations to reveal the nature of discontinuities.—E.S.L.

**Jamieson, John C.** *See* McQueen, Robert G. 00773

00855 **Jenkins, D. Graham.** Recent distribution, origin, and coiling ratio changes in *Globorotalia pachyderma* (Ehrenberg): Micropaleontology, v. 13, no. 2, p. 195–203, illus., tables, 1967.

*Globorotalia pachyderma* (Ehrenberg) is sinistrally coiled in polar and subpolar seas and dextrally coiled towards lower latitudes. In the New Zealand upper Cenozoic, *G. pachyderma* possibly evolved from *Globorotalia continuosa* Blow. There are ten alternating sinistral and dextral populations of *G. pachyderma* which have been interpreted as indicative of alternating cold and warmer marine conditions. Comparison is made with upper Cenozoic *G. pachyderma* coiling ratios of New Zealand, Italy, and California.—*from* Author's abstract

10764 **Jennings, Charles W.** State geologic maps of California—A brief history, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 5–16, illus., 1966.

The first geologic map of part of California was published more than 125 years ago, and nearly 100 years have passed since the first map of the entire State was prepared. The history of geologic exploration and mapping is closely associated with the economic and social development of the State, especially the search for gold, and also the surveys for railroad routes to the Pacific. The discussion focusses mainly on those pioneers who prepared the first geologic maps on a state-wide scale.—M.S.T.

00646 **Jensen, James A.** Dinosaur eggs from the Upper Cretaceous North Horn Formation of central Utah: Brigham Young Univ. Geology Studies, v. 13, p. 55–67, illus., 1966 [1967].

The fossil eggs discovered in the Wasatch Plateau include the first found in the western hemisphere which may be attributed to dinosaurs. The new material represents, from one area, various types of eggs described from widely separated regions of the world, making possible a more realistic distinction between fossil eggs of reptiles and birds. Some of the fragments may have a bearing on the origin of birds from reptilian ancestry. Here are the greatest variety, although not the greatest volume, of fossil egg materials to be found in Mesozoic sediments. Three broad types, recognized by external appearance, are: Class A, egg shells with smooth exterior surface; Class B, with a nodose or nodular surface; and Class C, fragments having a sculptured exterior surface.—G.D.C.

00745 **Jinks, D. D.; Perkins, H. F.** Mineralogy of alluvial sediments in the Coastal Plain [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 88, 1967.

**Joensuu, Oiva I.** *See* Wangersky, Peter J. 00632

10713 **Johnson, A. I.; Moston, R. P.; Versaw, S. F.** Laboratory study of aquifer properties and well design for an artificial-recharge site: U.S. Geol. Survey Water-Supply Paper 1615-H, p. H1-H42, illus., tables, 1966.

Hydrologic and physical properties of the aquifer in the Grand Prairie region, Ark., were determined from analysis of samples taken at a recharge well and nearby test holes. Estimated quantitative characteristics are: coefficient of transmissibility, 60,000 gpd/ft; specific yield about 0.34. Gravel content of the aquifer is highest in basal Quaternary sediments deeper than 115 feet, where median diameter is about 0.5 mm and uniformity coefficient between 1 and 2. Upper Quaternary sands consist mostly of fine particles with median diameter near 0.1 mm and average uniformity coefficient about 16. Experiments indicated compaction of the filter pack and pumping and injection tests could cause a permeability reduction of approximately 25 percent.—*from* Authors' abstract

00933 **Johnson, J. O.; Edwards, K. W.** Determination of strontium-90 in water: U.S. Geol. Survey Water-Supply Paper 1696-E, p. E1-E10, illus., 1967.

A method is described for the determination of strontium-90 in waters free of strontium-89, or for determination of gross radiostrontium activity as strontium-90. The method is suitable for use on natural water samples and other aqueous systems in the absence of high concentrations of organic substances which form stable complexes with strontium. The minimum detection limit at the 95-percent confidence level is 1.55 picocuries per liter for the recommended 500-milliliter sample.—Authors' abstract

00882 **Johnson, Michael; Lundeen, Edgar W.** Alamitos barrier project—Resume of geohydrologic investigation and status of barrier construction: Eng. Geology, v. 4, no. 1, p. 37-49, illus., 1967.

To prevent sea water intrusion into ground water aquifers in the Alamitos Gap area, Long Beach, Calif., a fresh-water barrier is being constructed. This consists of recharging the aquifer and developing a fresh-water mound by a line of injection wells inland from the zone of exposure of Recent fluvial deposits, which are in contact with the aquifer and with tidal waters, and by lowering of the Recent zone water level, seaward of the injection well alignment, by a series of pumping wells. The barrier was placed across Alamitos Gap in an arc from the most inland margin of the exposure zone into the Seal Beach fault, a natural barrier, at each end. Recharge line operation, though incomplete, has resulted in a pressure rise at all observation wells and considerable freshening in all intruded zones of the aquifer.—M.S.T.

**Johnson, R. D.** *See* Nelson, S. J. 10914

00819 **Johnson, Ralph Gordon.** Salinity of interstitial water in a sandy beach: Limnology and Oceanography, v. 12, no. 1, p. 1-7, illus., tables, 1967.

Salinity in the upper 20 cm of intertidal sands was observed at two stations in Tomales Bay, Calif. In summer there were no striking variations associated with elevation, except for the effect of evaporation. In winter influx of freshwater provides sufficient contrast between interstitial and open water to reveal features of circulation. High on the beach the interstitial salinity at depths of 10 to 20 cm remains low through the tidal cycle. At an elevation of 1.0 m, these salinities converge; below this elevation interstitial salinity varies less than in the adjacent open waters of the bay. The environment of the infauna of the low intertidal zone is more stable than that of epifaunal or pelagic organisms in shallow water. Variations high in the intertidal zone must be a major obstacle to the spread of marine organisms there.—*from* Author's abstract

00637 **Johnson, William D., Jr.; Adkison, W. L.** Geology of eastern Shawnee County, Kansas, and vicinity: U.S. Geol. Survey Bull. 1215-A, p. 1-123, illus., tables, geol. map, 1967.

In this area of about 355 sq mi of northeastern Kansas unexposed sedimentary rocks are from Late Cambrian to Late Pennsylvanian in age and up to 2,700 feet thick. The Precambrian basement complex has been penetrated in two wells. Exposed sedimentary rocks, about 725 feet thick in the Late Pennsylvanian Shawnee and Wabaunsee Groups, are thick shale formations and alternating thinner limestone formations which record a cyclic pattern of deposition. Kansan unstratified and unsorted clay till covers most of the area; stratified glacial outwash occurs along the Kansas and Wakarusa Rivers, associated with alluvial material of Quaternary age. Outcropping rocks strike about N. 20°–30° E. and dip northwest 20–40 feet per mile. No oil or gas in commercial quantities has been found, but coal was formerly mined from the Nodaway coal bed. Limestone, sand, and gravel are quarried commercially.—V.S.N.

00737 **Johnson, William D., Jr.; Wagner, H. C.** Geology of western Shawnee County, Kansas, and vicinity: U.S. Geol. Survey Bull. 1215-B, p. 125–246, illus., table, geol. map, 1967.

In this area of about 358 sq mi of northeastern Kansas subsurface sedimentary rocks are Late Cambrian to Late Pennsylvanian, up to 3,300 feet thick; Precambrian granite has been penetrated in one well. Exposed sedimentary rocks, about 600 feet thick, are in the Late Pennsylvanian Wabaunsee and Early Permian Admire and Council Grove Groups. Thick units of claystone, siltstone, and sandstone alternating with thinner units of limestone record cyclic deposition. Kansan glacial drift covers much of the northern two-thirds of the area; thick stratified glacial-outwash deposits occur locally across the southern part and to the north along Kansas River valley. Kansas and Wakarusa River and larger creek valleys are filled with Quaternary alluvial material. Outcropping rocks strike about N. 15°–30° E. and dip northwest at 15–30 feet per mile.—*from* Authors' abstract

00885 **Johnston, F. J.** Vermilion Lake area, North Pines sheet, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 408, scale 1 in. to 1/4 mi., text, 1967.

The North Pines sheet of the Vermilion Lake area is traversed by two belts of northeast-trending metavolcanics separated by a metasediment belt about 7,000 feet wide near the area's center. The northern belt consists mainly of intermediate to mafic flows, whereas pyroclastic rocks form about one-third of the southern belt. Granitic rocks intrude the metavolcanics in the north and the metasediments east of the map area. The Little Vermilion fault trending northeast marks the contact between the metasediments and metavolcanics; the presence of major fold structures has not been established. More than 500,000 tons of pyrite for chemical use was produced from North Pines mine from 1909–21. No other deposits of equal importance have been found.—M.C.M.

**Jones, F. P.** *See* Chelini, J. M. 10783

10830 **Jumikis, Alfreds R.** Some engineering aspects of Brunswick shale [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 99–102, tables, 1966.

The mounting frost damage to roads in New Jersey built over Brunswick Shale has led to an investigation of engineering properties of the shale. Results indicate that failures are attributable to anisotropy (stratification) and unequal response to ground water and hydraulic pressure. The problem of evaluating shale as an engineering material is examined, and it is noted that shales exhibit wide differences in physico-mechanical properties. Small laboratory specimen tests are not representative of in situ properties of a shale formation. Sound shale may possess great compressive strength but the zone of weathered shale is less reliable for supporting heavy structures.—V.S.N.

00775 **Kaarsberg, Ernest A.** Magnetic survey of the Puget Sound earthquake zone: Geophysics, v. 32, no. 1, p. 119–123, illus., 1967.

The Puget Sound earthquake of 29 April 1965 had a magnitude of 6.5 and focal depth of 60 km. On the Bouguer gravity map the epicenter lies on the nose of a high trend from the west which drops off steeply to the northeast, which has

been interpreted (Danes and others, 1965) as being due to an igneous horst. A vertical magnetic survey showed that the epicenter lies on or near the nose of a magnetic high which corresponds to the gravity high. A total intensity magnetic survey corroborated the correlation between the gravity and magnetic anomalies in the epicentral area. The data indicate that a contact zone between large basaltic and sedimentary rock masses underlies the 1965 epicenter, that this contact extends deep into the crust, and that fault movements are closely associated with this zone.—D.B.V.

00876 **Kahle, Anne B.; Vestine, E. H.; Ball, R. H.** Estimated surface motions of the Earth's core: Jour. Geophys. Research, v. 72, no. 3, p. 1095–1108, illus., table, 1967.

Previous work on inferred surface fluid motions of the Earth's core is improved and extended for epoch 1955, using geomagnetic secular changes for 1912–55. In addition to westward drift (which does not appear to dominate the flow) there is a strong upflow in the northern hemisphere, centered in the Mediterranean. Although a downflow in the northern Pacific is still obtained, the improved estimate has resulted in major changes in the derived flow. There also are strong rotational velocities, particularly in the region of Africa.—D.B.V.

00658 **Kay, Marshall.** Stratigraphy and structure of northeastern Newfoundland bearing on drift in North Atlantic: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 4, p. 579–600, illus., 1967.

In the Notre Dame Bay area, there are three essentially east-northeast-trending sequences of Ordovician and Silurian rocks, separated by two faults. The tectonic history of central Newfoundland after Silurian deposition involved formation of folds with steeply plunging axial lines and sinuous bed patterns. After folding, rock sequences were separated by high-angle, probably transcurrent, faults, later offset by other transcurrent faults. The stratigraphic and structural belts of northeastern Newfoundland have many similarities with those in the British Isles and southern New England. If belts in Europe and northeastern North America once were continuous, they have been offset about 500 miles by transcurrent faults in the North Atlantic; if not continuous beneath the ocean, the drift hypothesis requires separation of more than 1,000 miles in addition to the 500-mile right-lateral displacement.—E.A.M.

10854 **Kay, Marshall.** Newfoundland structures and continental drift: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 613–620, illus., 1966.

Trends of transcurrent faults, directions of movement, and similarity in the stratigraphic sequence in Newfoundland, Ireland, and Scotland suggest that Newfoundland and Ireland were separated by continental drift.—J.R.G.

**Keen, C. E.** *See* Dainty, A. M. 10687

**Keen, M. J.** *See* Dainty, A. M. 10687

10742 **Keen, M. J.; Blanchard, J. E.** The continental margin of Eastern Canada, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 9–18, illus., 1966.

Seismic refraction profiles giving depths to the Moho have been obtained on the Nova Scotia coast, continental slope and shelf, across the roots of the Appalachian system in the Gulf of St. Lawrence, and on the west and northeast coasts of Newfoundland. There is a normal crust 35 km thick with a very thin or no intermediate layer at the continental margin off Nova Scotia. Sea gravity data combined with seismic information indicates a density difference between continental and oceanic upper mantle material. The crust and upper mantle northeast of Newfoundland are both different from those off Nova Scotia. Deep seismic refraction studies enable one to trace the roots of the Appalachian system from the Gulf of St. Lawrence across Newfoundland. An intermediate crustal layer is present, the crust is about 50 km thick, and a seismic velocity of 8.5 kmps was obtained from the upper mantle.—*from* Authors' abstract

00670 **Kemp, Warren C.; Eger, Donald T.** The relationships among sequences with applications to geological data: Jour. Geophys. Research, v. 72, no. 2, p. 739–751, illus., 1967.

Power spectrum density analysis of isotopic variations and other temperature-dependent parameters in the Caribbean cores P6304–8 and P6304–9 yields spectrums which to good approximation are identical with the power spectrum of summer insolation variation at 65° N. Identification of the various peaks in the spectrums as astronomical frequencies leads to an accurate method for determining the sedimentation rate in the cores. These rates are in good agreement with those obtained by correlating these cores with others that have been absolutely dated.—Authors' abstract

00878 **Kendall, Robert C.** The role of the geophysicist in expanding man's domain: Geophysics, v. 32, no. 1, p. 1–7, illus., 1967.

This is the presidential address presented at the 1966 annual meeting of the Society of Exploration Geophysicists. The primary goals of the space exploration program are certainly geophysical, defined broadly. Physical oceanography is also in large measure geophysical exploration. Of great practical significance is the expanded investigation of earthquake phenomena, which hopefully will lead to prediction of earthquakes, or at least of the probability of occurrence. The contributions of the seismograph to stratigraphy are discussed; petroleum exploration on land in the United States must be increasingly directed toward the location of stratigraphic traps.—D.B.V.

00669 **Kennard, O.; Speakman, J. C.; Donnay, J. D. H.** Primary crystallographic data: Acta Cryst., v. 22, pt. 4, p. 445–449, illus., 1967.

A report [is given] containing a list of recommendations on the presentation of crystallographic data in primary publications relating particularly to single-crystal work. The more important items of information are discussed in detail with examples. Numerical values of certain constants in common use are recorded.—Authors' abstract

**King, Elizabeth R.** *See* Zietz, Isidore. 10812

00723 **Kittrick, J. A.; Hope, E. W.** A procedure for the identification of small crystals by X-ray diffraction analyses: Am. Mineralogist, v. 52, nos. 1–2, p. 286–294, illus., tables, 1967.

Single crystals mounted on a tungsten wire give discontinuous spots upon a powder pattern. A grid including tungsten reflections as an internal standard was constructed for determining d-spacings away from the equator; the spots on the powder pattern were projected on the grid, matching tungsten reflections, and the combined powder pattern and grid were photographed. Powder patterns were reconstructed from the data.—M.L.L.

00729 **Kittrick, J. A.; Hope, E. W.** Organic dyes and strychnine-molybdate reagent as aids in isolating phosphate mineral grains: Am. Mineralogist, v. 52, nos. 1–2, p. 263–272, tables, 1967.

Seventy phosphate minerals formed a blue complex when treated with strychnine-molybdate. Lists of phosphate minerals that reacted and nonphosphate minerals which did not react to this and other organic dyes are given.—M.L.L.

00695 **Klein, Martin.** Side scan sonar: Undersea Technology, v. 8, no. 4, p. 24–26, 38, illus., 1967.

The side scan sonar is a compromise between the ultra high resolution short range acoustic lens imaging systems and the long range, low resolution submarine sonars. It can be used to locate and outline objects and terrain on the ocean floor by means of repeatedly projecting short pulses of acoustic energy in a fan shaped beam from a vessel carrying the system. Return signals from any object are continuously recorded graphically to show lateral displacement. This ability to produce a

permanent, continuous, graphic record is the most important feature of the side scan sonar. The transducers, pulse length, signal processing, recorder, range, and record interpretation are discussed briefly.—V.S.N.

**Knight, R. J.** *See* Somayajulu, B. L. K. 10795

00914 **Knopoff, Leon; Mal, A. K.** Phase velocity of surface waves in the transition zone of continental margins—[Pt.] 1, Love waves: Jour. Geophys. Research, v. 72, no. 6, p. 1769–1776, illus., 1967.

The phase velocity of surface waves in the transition zone of a thickening layer is found to be severely influenced by back reflections from the structure beyond the seismic observatory. This feature is more important in producing phase shifts than is the shift in the eigen-value due to the inclined geometry. The effect of an inclined upper surface and an inclined Moho on the phase velocities of Love waves in a single layer are computed. For surface waves traveling from the thinner to the thicker layer, the upper surface produces no calculable effect. For both directions of propagation for an inclined Moho and for propagation from the thicker to the thinner layer for an inclined upper surface, the effect is a maximum in the period range 25 to 45 sec and has a phase shift whose sign is undeterminable in the absence of precise information about the geometry.—Authors' abstract

00739 **Koch, George S., Jr.; Link, Richard F.** Geometry of metal distribution in five veins of the Fresnillo mine Zacatecas, Mexico: U.S. Bur. Mines Rept. Inv. 6919, 64 p., illus., tables, 1967.

Distribution of metals in five major veins within the northwestern part of the Fresnillo deposit and below the zone of oxidation was determined by assay of about 16,000 mine samples of ore in place. The veins are subparallel, about 1 m wide, and classified as epithermal to mesothermal. Linear and quadratic trend surfaces, fitted by regression analysis to lead, zinc, silver, and gold values, show broad domelike distribution patterns within individual veins. Trend surfaces oriented athwart the veins (plan view) show a domelike pattern for lead and zinc, but basinlike for gold and silver. Statistical analysis of silver/lead ratios confirm the presence of two geographically distinct types of mineralization. In one silver is related to lead, in the other it is independent of lead.—K.F.F.

00751 **Koch, George S., Jr.; Link, Richard F.** Gold distribution in diamond-drill core from the Homestake mine, Lead, South Dakota: U.S. Bur. Mines Rept. Inv. 6897, 27 p., illus., tables, 1967.

Drill cores from five holes aggregating 56 feet in length, all in the orebody, were sawed into 1-inch long sections. Two random pairs of adjacent sections from each foot were assayed for gold. The frequency distribution of gold content is highly skewed, with 167 of the 219 assays falling in the 0.0 to 0.5 ounces per ton range. The variability in gold distribution is greater than that recorded from orebodies at a number of other mines. The variability from foot to foot in a drill hole is greater than that between samples of a pair or between sample pairs within the same foot, and much greater than the variability between drill holes or between stopes. The mean gold content of the 219 assays is 1.25 ounces per ton, but would be only 0.50 if the highest eight assays were omitted.—K.F.F.

**Kohnen, H.** *See* Brockamp, B. 10930

**Kolesnikov, L. V.** *See* Barsanov, G. P. 10717

**Komada, Eiji.** *See* Akimoto, Syun-Iti. 00675

10833 **Kondner, Robert L.** Energy storage and dissipation properties of rocks from creep test response [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 273–275, illus., 1966.

Methods are presented to determine the energy storage and energy dissipation response properties of rocks using the results of creep tests. Energy dissipation

is expressed in terms of the loss tangent of viscoelasticity and the elastic or storage part of the response is represented by the storage compliance. Complex compliance representation is also given. Nonlinear and nonideal response is handled by using numerical approximations to evaluate the integral transforms with piecewise continuous straight line approximations of the creep data. Comparison of static and dynamic behavior is presented through transformation from the time domain to the frequency domain.—Author's abstract

00829 **Koteff, Carl; Oldale, R. N.; Hartshorn, J. H.** Geologic map of the North Truro quadrangle, Barnstable County, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-599, scale 1:24,000, text, 1967.

On Cape Cod, the source of the Wellfleet, Truro, and Highland plains deposits was the South Channel ice lobe of the last advance that lay east of Cape Cod; the Highland is lower than the Wellfleet and higher than the Truro. On the basis of grain size and bedding, a lacustrine origin for the plains is suggested; the upper parts of their deposits are fluvial sediments, locally at least 80 feet thick. Radiocarbon ages of marine shell fragments in the Wellfleet and Highland plain deposits are greater than 25,000 B.P. Valleys were probably cut during late-glacial time. The map sheet includes measured sections, a table of stone counts, and diagrammatic measured sections at Highland Light.—M.C.M.

00674 **Ku, Chao-Cheng; Sun, Stanley; Soffel, Heinrich; Scharon, LeRoy.** Paleomagnetism of the basement rocks, Wichita Mountains, Oklahoma: Jour. Geophys. Research, v. 72, no. 2, p. 731-737, illus., table, 1967.

Measurement of paleomagnetism in the basement rocks of the Wichita Mountains, Oklahoma (Cambrian age), resulted in a virtual geomagnetic pole (VGP) position of 33.5° N., 135° E., which correlates with VGP's of Carboniferous rocks in North America. The remanent magnetization (RM) of greatest reliability is a CRM due primarily to secondary hematite derived from magnetite and(or) titanomagnetite. Mineralogical studies indicate that the time of CRM acquisition can be correlated with a low-temperature metamorphism accompanying the uplift of the Wichita Mountains. The paleomagnetic results agree with geological observations that the Wichita Mountains were uplifted in Pennsylvanian time.—Authors' abstract

10802 **Kuno, Hisashi.** Lateral variation of basalt magma across continental margins and island arcs, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 317-335, illus., 1966.

In the Circum-Pacific belt, the transitional zone between oceanic and continental structures is characterized by lateral variation of magma type from tholeiite on the oceanic side, to high-alumina basalt in the intermediate zone, to alkali olivine basalt on the continental side. Correspondence between depth of earthquake foci and magma types indicates that tholeiite is produced at 100 km, high-alumina basalt at 100-200 km, and olivine basalt at depths greater than 200 km. The steep thermal gradient in the oceanic and gentle gradient in the continental mantle suggest that melting is reached at shallow depths on the oceanic side and at great depths on the continental side. Primary magma on the oceanic side leaves the source region and forms a reservoir at shallow depths where fractionation occurs under low pressure; on the continental side fractionation takes place under high pressures in a reservoir close to the source.—B.S.H.

10681 **Kuo, John T.; Ewing, Maurice.** Spatial variations of tidal gravity, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10(Natl. Acad. Sci.-Natl. Research Council Pub. 1567), p. 595-610, illus.,tables, 1966.

The effect of geologic structures on tidal gravity is found to be secondary to ocean tidal loading. The effect of the latter on observed values of the gravimetric factor and phase in the distance range from 1° to 20° is found to decay approximately exponentially as a function of the station distance from the effective ocean water. By taking into account ocean tidal loading, the observed and theoretical values of tidal gravity are now in good agreement; in turn, existence of free diurnal nutation

of the Earth is verified. It will continue to be very difficult to isolate the effect of regional geologic structural variations, until values from a network of densely populated tidal gravity stations are available.—*from* Authors' abstract

00681 **Kuroda, P. K.; Clark, R. S.; Ganapurthy, R.** Excess xenon 129 and tellurium abundances in chondritic meteorites: Jour. Geophys. Research, v. 72 no. 4, p. 1407–1410, illus., table, 1967.

The new term "Te–128—Xe–129 formation interval" is introduced, to denote formation intervals calculated on the basis of the equation for production of I–129 by neutron–induced reactions on Te–128. The Te–128—Xe–129 formation interval for Renazzo, a meteorite believed to represent a most primitive state of meteoritic matter, is almost zero. There is no clear relationship between excess Xe–129 and iodine contents of several meteorites examined. A tentative timetable for the sequence of events between nucleosynthesis and formation of the solar system is presented; it is surprising that meteorites of different degrees of metamorphism have the same formation interval.—D.B.V.

00890 **Kustra, C. R.** Obonga Lake area, west part: Ontario Dept. Mines Prelim. Geol. Map P. 416, scale 1 in. to 1/4 mi., text, 1967.

All rock exposures in the eastern part of the Obonga Lake area are Precambrian; locally a thick layer of glacial drift and lake deposits covers bedrock. A northeast–trending synclinal belt of intercalated metavolcanics and metasediments (major structural feature) occupies the west–central part; granitic rocks extend for a considerable distance north of this complex. The eastern part of the synclinal belt and granitic gneiss is overlain by flat–lying to gently east–dipping sandstone and a magnetite–bearing Keweenawan diabase sheet. Puddy Lake serpentinite is the most economically important rock unit; there are evidences of chromite, copper, and nickel mineralization.—M.C.M.

00907 **Kustra, C. R.** Obonga Lake area, east part: Ontario Dept. Mines Prelim. Geol. Map P. 417, scale 1 in. to 1/4 mi., text, 1967.

The text for the Obonga Lake area is abstracted with the citation for Map 416, also by Kustra.—M.C.M.

10835 **Ladanyi, B.** Failure mechanism of rock under a plate load [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 415–420, illus., 1966.

In this paper, on the basis of experimental evidence obtained by different investigators, some general conclusions are made concerning the behavior of rock during indentation, and a new mathematical model is proposed which may be able to approximate an important type of rock failure in indentation: failure by radial expansion. A fair agreement is found between the proposed theory and the results of indentation tests on concrete performed by Meyerhof (1953).—Author's summary

10841 **Ladanyi, B.; Nguyen, D.** Discussion [of "Plate–load testing on rock for deformation and strength properties," by D. F. Coates and M. Gyenge, 1966], *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 36–40, 1966.

This is a discussion of a paper (ibid., p. 19–35) dealing with plate–load tests on rock underground to determine in situ strength and deformation properties. Tests were made on iron ore, paint rock and ash rock. The authors show an alternate approach to the problem of incipient failure under a plate load. The concept consists of finding the minimum load at which the failure condition is satisfied in the ground, at least in a single point. The region of loading between the incipient and ultimate failure is thought to correspond to the intermediate phase of failure during which the local fractured zone beneath the plate is acting on the surrounding material as an expanding spherical bulb.—M.S.T.

**Lamb, Donald R.** *See* Duguid, James O. 00665

10701 **Landisman, Mark; Sato, Yasuo; Usami, Tatsuo.** Propagation of disturbances in a Gutenberg–Bullen A′ spherical earth model—Travel times and amplitudes of S waves, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 482–494, illus., 1966.

Spectral contributions from many torsional modes of the Gutenberg–Bullen A′ earth model are summed to produce theoretical seismograms. Traveltimes and amplitudes of body waves on these seismograms are compared with results from ray theory, and the agreement is satisfactory. The signal quality of these records can be significantly improved by proper choice of the number of modes used for the summation process. Rays that reach great depths in the mantle are discussed in terms of the higher group velocities associated with the higher radial modes. Authors' abstract

**Langway, Chester C., Jr.** *See* Hodge, Paul W. 00776

**Lanphere, Marvin A.** *See* Loney, Robert A. 00690

00887 **Larochelle, A.** The palaeomagnetism of the Sudbury diabase dyke swarm [with French abs.]: Canadian Jour. Earth Sci., v. 4, no. 2, p. 323–332, illus., tables, 1967.

Previously published results on the paleomagnetism of the Sudbury [Ontario] diabase dike swarm had indicated that these dikes were formed at low palaeomagnetic latitude. A new and independent set of data described in the present study confirms this view and suggests further that the dikes were not disturbed significantly since the time of their intrusion, over 1,000 m.y. ago. It is also suggested that the dikes sampled were intruded intermittently over a period extending for less than 10,000 years.—Author's abstract

10916 **Larson, M. L.; Jackson, D. E.** Biostratigraphy of the Glenogle formation (Ordovician) near Glenogle, British Columbia: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 486–503, illus., 1966.

The Glenogle Formation (Ordovician) at its type section consists of poorly exposed graptolite-bearing black shale of undetermined thickness. Five graptolite zones were recognized in the type area.—J.R.G.

**Laughlin, A. William.** *See* Livingston, Donald E. 00680

**Leahy, E. J.** *See* Bennett, G. 00924

**Leahy, T.** *See* Bennett, G. 00916

**Leahy, T.** *See* Bennett, G. 00943

10808 **Lee, W. H. K.; Uyeda, S.; Taylor, P. T.** Geothermal studies of continental margins and island arcs, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 398–414, illus., tables, 1966.

The thermal regime in continental margins and island arcs was investigated by analyzing the existing heat flow results and other pertinent data. Heat flow patterns across the continental margins were found to be correlatable with geological features. Time series analysis of ocean water temperature records indicated that annual and semidiurnal temperature variations are dominant in the oceans. These suggest that oceanic heat flow measurements can be carried out in shallow water, provided that the probe penetrates beyond a depth of about 3 m.—Authors' abstract

10875 **Lee, W. H. K.** The present state of heat flow observations: Bull. Volcanol., v. 29, p. 313–325, illus., table, 1966.

Analysis of about 2,000 terrestrial heat flow observations indicates that heat flow values are well correlated with major geological features: higher averages and more scattered values in active tectonic areas, and lower averages and more uniform values in stable areas. Average heat flow over the continents does not differ significantly from that over the oceans. This equality of heat flow suggests that radioactive elements per unit volume are about the same beneath land and sea. This further implies that the upper mantle under the continents is different from that under the oceans. Thermal history of the Earth deduced from recent observations is described also.—D.B.V.

10850 **LeGrand, H. E.; Stringfield, V. T.** Development of permeability and storage in the Tertiary limestones of the southeastern states, U.S.A.: Internat. Assoc. Sci. Hydrology Bull., v. 11, no. 4, p. 61–73, illus., 1966.

Permeability and storage in these limestones have developed progressively but nonuniformly as circulation of water and solution in the limestone have changed during geologic history. The limestones, predominantly Eocene, are widespread at and beneath the surface, dipping seaward and covered in coastal areas by Miocene to Recent clays and sands. Circulation of water under water-table conditions when the limestone was exposed to meteoric weathering before middle Miocene time developed secondary permeability as solution channels near the surface. Marine deposition and later emergence converted part of that circulation system to the present great artesian system. Pleistocene changes in sea level effected changes in places of discharge, causing changes in rates of circulation and positions of solution of limestones.—G.D.C.

10894 **Leighty, R. D.** Terrain information from high altitude side-looking radar imagery of an Arctic area, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 575–597, illus., tables, 1966.

Radar imagery was obtained at altitudes of 30,000 to 60,000 feet over Arctic terrain [Greenland] with the AN/APQ56 (XAA) side-looking radar (high altitude) set during two flight programs (November–December 1960 and March 1962). Generalities of terrain information retrieval from radar imagery are presented with background information on the regional terrain characteristics in northwest Greenland and discussion of representative project imagery.—Author's abstract

10913 **Lenz, A. C.** Upper Silurian and Lower Devonian paleontology and correlations, Royal Creek, Yukon Territory—A preliminary report: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 604–612, 1966.

Upper Silurian (Ludlovian) through upper Lower Devonian (Emsian) rocks form an apparently gradational sequence of limestone and shale, 1,500 feet thick. The succession at the headwaters of Royal Creek is divisible into six faunal units. These units and their ages, in ascending order, are: *Monograptus nilssoni*, early Ludlovian; *Atrypella tenuis*, possibly middle or late Ludlovian; *Gypidula cf. pelagica*, Gedinnian; *Spirigerina*, Siegenian; *Gypidula sp. 1–Biconostrophia*, late Siegenian and early Emsian; and *Nymphorhynchia pseudolivonica–Sieberella*, Emsian.—C.A.S.

00791 **Levorsen, A. I.; Berry, Frederick A. F.** Geology of petroleum (2d edition): San Francisco, Calif., and London, W. H. Freeman and Co., 724 p., illus., tables, 1967; originally published 1954.

This standard text and reference book presents a broad treatment of many facets of geology and engineering related to petroleum geology, covering thoroughly various types and geometrics of petroleum traps. In this second edition new material deals primarily with the importance of fluid mechanics in migration and accumulation of petroleum. The chapter on the origin of petroleum has been extensively revised; sections on hydrodynamics and capillary pressure were revised and edited by F. A. F. Berry.—G.D.C.

**Lewis, Charles F.** *See* Moore, Carleton B. 10794

00708 **Lewis, John F.** Unit cell dimensions of some aluminous natural clinopyroxenes: Am. Mineralogist, v. 52, nos. 1–2, p. 42–54, illus., tables, 1967.

High total aluminum and high aluminum in four-fold coordination correlate with reduction in the $b$ and $a \sin \beta$ parameters and increase in $c$. Aluminum, trivalent iron, and titanium substituting in octahedral positions may each cause some reduction in $b$, but the total substitution is not linearly correlated with a reduction in $b$ and $a \sin \beta$.—M.L.L.

**Leyden, Robert.** *See* Ewing, J. I. 10822

**Lilly, J. E.** *See* Meade, Buford K. 10878

**Link, Richard F.** *See* Koch, George S., Jr. 00739

**Link, Richard F.** *See* Koch, George S., Jr. 00751

**Lipschutz, M. E.** *See* Jaeger, R. R. 00781

00680 **Livingston, Donald E.; Damon, Paul E.; Manger, Richard L.; Bennett, Richmond; Laughlin, A. William.** Argon 40 in cogenetic feldspar-mica mineral assemblages: Jour. Geophys. Research, v. 72, no. 4, p. 1361–1375, illus., tables, 1967.

K and Ar analyses on cogenetic feldspars and micas in four plutons, two pegmatites, and one metamorphic terrain indicate that (1) albite and plagioclase have equal or greater argon retentivity than their cogenetic micas, (2) some Tertiary K-feldspars may quantitatively retain argon, and (3) intense metamorphism can thoroughly degas both feldspars and micas. K-Ar ages of plagioclase from two Precambrian quartz monzonites are nearly the same as those of cogenetic biotite and muscovite, and concordant with Rb-Sr whole-rock isochron and mica ages of 1,420 m.y., demonstrating that plagioclase from Precambrian acidic plutonic rocks can be as precise a chronometer as micas.—D.B.V.

10686 **Lomnitz, Cinna; Hax, Arnoldo.** Clustering in aftershock sequences, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 502–508, illus., tables, 1966.

Two hypotheses were examined concerning the random nature of aftershock sequences: 'independence' and 'clustering.' Clustering obtains when individual aftershocks tend to develop smaller aftershock sequences of their own. Four aftershock sequences and an artificially generated Poisson control sequence were tested for clustering by the Neyman-Scott method, using an exponential cluster model and with Poisson distribution of centers. An expression for the quasi correlation coefficients $Q_k$ for this model was derived. When the decay trend of aftershock sequences was removed . . . it was found that both the Kern County, 1952, and the Alaska, 1964, aftershock sequences were uncorrelated. The San Francisco, 1957, sequence contained many small shocks in the magnitude range 1.6–2.5; removal of these yielded a sequence of uncorrelated events.—Authors' abstract

00690 **Loney, Robert A.; Brew, David A.; Lanphere, Marvin A.** Post-Paleozoic ages and their relevance to fault movements, northern southeastern Alaska: Geol. Soc. America Bull., v. 78, no. 4, p. 511–526, illus., tables, 1967.

Recently determined lead-alpha and potassium-argon ages indicate major plutonic events, as follows: Middle or Late Jurassic, 144–164 m.y.; Early Cretaceous, 103–117 m.y.; Eocene, 42–48 m.y.; and Oligocene to Miocene, 24–31 m.y. The present data show no distinctive areal pattern for the Mesozoic plutons, but those of known Tertiary age are restricted to Baranof and Kruzof Islands, along the margin of the Pacific Ocean. Stratigraphic and petrologic evidence, and radiometric ages indicate that Baranof Island and possibly Chichagof Island have been uplifted several kilometers since Miocene time, whereas Admiralty Island to the east appears to have been relatively stable since Paleocene time. This movement apparently took place on the Chatham Strait fault.—R.A.L.

**Lotspeich, F. B.** *See* Hauser, V. L. 00718

00912 **Love, Colin L.** A geophysical study of a highway problem in limestone terrain: Eng. Geology, v. 4, no. 1, p. 50–62, illus., 1967.

Geophysical methods have been used to find solution cavities where sink holes have developed next to a highway near Cool, California. The area is underlain by limestone of the Carboniferous Calaveras group. Shallow refraction seismic, expanding spread resistivity, and fixed depth resistivity geophysical methods were evaluated. Only the fixed depth resistivity traverses gave promising results.—M.S.T.

00891 **Lovell, H. L.** Maisonville township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 409, scale 1 in. to 1/4 mi., text, 1967.

All bedrock in Maisonville township is Precambrian. From oldest to youngest the rocks are Keewatin–type mafic and silicic flows, tuffs, and agglomerates, Keewatin or Timiskaming age slate; Haileyburian–type mafic to ultramafic stocks and bosses; Algoman–type silicic stocks and cupolas; Matachewan–type mafic intrusive dikes; and Cobalt sedimentary rocks. Volcanic rocks in the south form part of a synclinorium in which the synclinal axes strike south; in Benoit township to the north is a younger east–plunging syncline; the volcanic and steeply dipping sedimentary strata of the northern part of Maisonville township are in the transition zone between the two synclines. Most faults, shear zones, and diabase dikes strike north, parallel to the strata. Base metals, gold, and silver are present in economically interesting concentrations.—M.C.M.

10858 **Lowman, Paul D., Jr.** The Earth from orbit: Natl. Geog. Mag., v. 130, no. 5, p. 644–671, illus., 1966.

Color photographs taken from the Gemini spacecrafts are presented with a discussion on the use of orbital photography for geology.—J.H.F.

10872 **Luedke, R. G.; Burbank, W. S.** Volcanism in the western San Juan Mountains, Colorado: Bull. Volcanol., v. 29, p. 345–346, 1966.

Three major cycles of volcanism during the Miocene and Pliocene formed a layered succession of calc–alkaline eruptive materials in the western San Juan Mountains. The resulting structure was a great volcanic plateau surrounded by a complex of nested cauldrons. The distribution of post–cauldron radial and concentric fractures, dikes, and intrusive plutons suggests that the underlying magma chamber must have been appreciably larger than the associated cauldrons.—D.B.V.

00852 **Lumbers, S. B.** Burwash sheet, Districts of Nipissing, Parry Sound and Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 415, scale 1 in. to 2 mi., 1967.

00908 **Lumbers, S. B.** (compiler). Tomiko sheet, District of Nipissing: Ontario Dept. Mines Prelim. Geol. Map P. 394, scale 1 in. to 2 mi., 1967.

**Lundeen, Edgar W.** *See* Johnson, Michael. 00882

00906 **Lustig; Lawrence K.; Busch, Robert D.** Sediment transport in Cache Creek drainage basin in the Coast Ranges west of Sacramento, California: U.S. Geol. Survey Prof. Paper 562–A, p. A1–A36, illus., tables, geol. map, 1967.

Rocks cropping out in the Cache Creek drainage basin range in age from Late Jurassic to Recent. Pliocene and Pleistocene continental deposits are apparently a major source of sediment in the basin and their erosion has resulted in badland topography. This topography and gullying combined with decrease in annual precipitation to the south, is probably the cause of a marked increase in sediment yield in the middle part of the basin. Sediment discharge increases downstream, but the rate of increase is much greater in the middle part of the basin than in the upper part. Various difficulties inherent in procedures for sampling of suspended sediment and the computation of both suspended and total sediment discharge lead to possibility of error but do not invalidate results of the investigation.—*from* Authors' abstract

**Luternaurer, John L.** *See* Pilkey, Orrin H. 00717

**Lynch, V. J.** *See* Hickman, R. C. 00740

10886 **Lyon, R. J. P.; Patterson, J. W.** Infrared spectral signatures—A field geological tool, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 215–230, illus., 1966.

A continuing evaluation of infrared remote sensing shows that field geology can be performed by using spectral signatures from rocks and soils in the 8 to 13 micron wavelength region. By matching the incoming spectrum with standard curves in the memory of a computer, the bulk composition of the rock surfaces can be established. Real-time evaluation of spectral rates up to 7 per sec appear feasible, permitting mapping from mobile vehicles, aircraft, and spacecraft. Over 1,000 spectral signatures have been obtained in a recently completed program, involving operation in rough mountainous and desert field conditions. Spaceflight applications to terrestrial and lunar problems are discussed.—*from* Authors' abstract

00822 **Lystrom, D. J.; Nees, W. L.; Hampton, E. R.** Ground water of Baker Valley, Baker County, Oregon: U.S. Geol. Survey Hydrol. Inv. Atlas HA-242, scale 1:96,000, text, 1967.

Most wells in Baker Valley are drilled in sedimentary sand and gravel units designated on the map as fluviolacustrine deposits, terrace gravel, terrace deposits, and alluvium; the units underlie the valley floor and yield moderate to large quantities of water to wells. Surrounding and underlying the valley at depth are the volcanic, intrusive, and metamorphic rocks. The intrusive and metamorphic rocks are poorly permeable and are not known to yield quantities of water adequate for domestic or stock supplies. Volcanic rocks, especially the Columbia River group, at places yield moderate to large quantities to wells where penetrated below the water table. Owing to complexities of ground-water movement and recharge, chemical quality of shallow ground water is subject to notable change. An inset map shows general patterns of water quality.—M.C.M.

00778 **MacClintock, Copeland.** Shell structure of patelloid and bellerophontoid gastropods (Mollusca): Yale Univ. Peabody Mus. Nat. History Bull. 22, 140 p., illus., tables, 1967.

Detailed descriptions and analyses of the microstructure and shell-layer relationships of Recent and fossil gastropods of the primitive superfamilies Patelloidea and Bellerophontoidea are given. In 121 patelloid species from around the world, prismatic, foliated, crossed, and complex-crossed types of shell structure are recognized; individual shells have four to six characteristic layers. With enough well-preserved shells throughout post-Ordovician patelloid history, a more accurate phylogeny of the group can be developed. Crossed-lamellar structure, previously unrecorded in Bellerophontina, has been observed in *Euphemites*, and complex crossed-lamellar structure in the inner layer of *Bellerophon (Pharkidonotus)*, both distantly related species of Pennsylvanian age. These are the earliest recorded occurrences of these structures in the Gastropoda.—G.D.C.

10737 **Macdonald, Gordon A.** Geology of the Cascade Range and Modoc Plateau, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 65–96, illus., 1966.

The northern part of the Cascade Range in California consists of Upper Cretaceous and Eocene sediments, succeeded by greenish volcanics of the Western Cascade series which were faulted and tilted eastward in late Miocene time. Southward, volcanic rocks of the Western Cascade are overlapped by those of the High Cascade, and south of the Shasta region the Western Cascade series has not been recognized. The Modoc region consists of northwest to north-trending block-faulted ranges, with the intervening basins filled with "plateau" basalt flows, or with small shield volcanoes, lava cones, cinder cones, and lake deposits; the rocks are Miocene to Recent in age. Faulting has continued into Recent time in the Modoc region.—M.S.T.

00774 **MacDonald, Gordon J. F.** What's in the ocean?, *in* The ocean's resources: Internat. Sci. and Technology, no. 64, p. 38–48, illus., 1967.

Aside from potential oil and gas structures, ore deposits of the continental shelf are of two main types: irregular shoestring placers of heavy minerals concentrated in rivers or beaches now submerged, and blankets of nodular minerals such as phosphorite precipitated from sea water. Diamonds, tin, gold, and iron have been mined from offshore placers. Phosphorite nodules and coatings on rocks are found where ocean waters rich in tricalcium phosphate upwell from great depths, for example off the coast of California. The deep sea floor is paved in many places with manganese nodules containing other metals in concentrations which approach levels now mined on land. Exploration problems are great, but geophysical methods at sea bottom are less contaminated by noise than on land surfaces. Complications of development include environment, pollution, submarine laws, and expense.—G.D.C.

**Mackin, J. Hoover.** *See* Blank, H. Richard, Jr. 00841

**Maddock, Marshall E.** *See* Brabb, Earl E. 10744

**Magouirk, J. N.** *See* Handin, John. 00699

**Mal, A. K.** *See* Knopoff, Leon. 00914

10864 **Malahoff, A.; Woollard, George Prior.** Magnetic measurements over the Hawaiian Ridge and their vulcanological implications: Bull. Volcanol., v. 29, p. 735–759, illus., table, 1966.

Results of an aeromagnetic survey of the Hawaiian Islands show that in nearly all cases anomalies can be attributed to intrusive masses at depths of 2–6 km; that these were probably derived from the underlying mantle is indicated by associated gravity anomalies and refraction measurements of the crust. Volcanism at the intersection of a NW–SE zone of tectonic weakness with the Molokai Fracture zone led to the formation of the Hawaiian Islands. The Ridge as a whole may have developed in response to a secular shift in crustal stress pattern at the intersection of two major translational fault systems.—D.B.V.

00627 **Malahoff, Alexander; McCoy, Floyd.** The geologic structure of the Puna submarine ridge, Hawaii: Jour. Geophys. Research, v. 72, no. 2, p. 541–548, illus., 1967.

Magnetic and bathymetric surveys over the seaward extension of the Puna rift zone show that the submarine extension of the zone over the Puna submarine ridge is characterized by an elongate, normally polarized magnetic anomaly of maximum amplitude of 2,270 gammas, representing a zone of magnetized intrusive rock from 4 to 6 km wide. These rocks originate at an average depth of 1,000 m below the crest of the ridge. Rocks of the intrusive zone beneath the ridge appear to be connected with intrusive rocks beneath the Kilauea caldera at a shallow depth and with intrusive rocks beneath Mauna Loa through a deep rift zone.—*from* Authors' abstract

00652 **Malde, Harold E.** Surficial geologic map of the Roxbury quadrangle, Litchfield and New Haven Counties, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ–611, scale 1:24,000, 1967.

10925 **Mallett, Gavin R.; Fay, Marie J.; Mueller, William M.** (editors). Advances in X ray analysis, V. 9—Denver Research Inst., Applications of X ray analysis, 14th Ann. Conf. 1965, Proc.: New York, Plenum Press, 544 p., illus., tables, 1966.

Of the 56 papers presented at this conference sponsored by the Metallurgy Division of the Denver Research Institute, 46 are included in this volume, as well as some open discussion. The subjects, representing a broad scope of applications of X-rays to a variety of disciplines, include such fields as electron-probe microanalysis, effect of chemical combination on X-ray spectra, and uses of soft and ultrasoft

X-rays in emission analysis. Several papers on special topics include X-ray topography and X-ray absorption fine-structure analysis.—G.D.C.

**Manger, Richard L.** *See* Livingston, Donald E. 00680

10670 **Mansfield, R. H.; Evernden, J. F.** Long-range seismic data from the Lake Superior seismic experiment, 1963-1964, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.-Natl. Research Council Pub. 1467), p. 249-269, illus., table, 1966.

Many of the chemical explosions of 1/8 to 10 tons detonated on the bottom of Lake Superior in 1963 and 1964 were detected at distances of 500 to 2,500 km. Traveltimes of $P_n$ and P, S, $L_g$, and some unidentified emergent phases were measured. Residuals of $P_n$ and P with reference to a constant velocity of 8.1 kmps when compared with results from the Nevada test site and the Gnome event in New Mexico confirm a regional difference between eastern and western $P_n$ velocities. Time residuals are considered in relation to crustal structure under Lake Superior. Amplitudes of $P_n$ and P and S or $L_g$ are shown, and the variation of amplitude with charge size measured for $P_n$ and P and S or $L_g$ for limits available. Energy considerations related to coupling and signal transmission are discussed and examples of signals shown.—*from* Authors' abstract

00694 **Mantei, Erwin J.; Brownlow, Arthur H.** Variation in gold content of minerals of the Marysville quartz diorite stock, Montana: Geochim. et Cosmochim. Acta, v. 31, no. 2, p. 225-235, illus., table, 1967.

Results of neutron activation analysis for gold carried out on 135 mineral samples from throughout the Marysville stock show that high gold values occur mainly near the edge of the stock and lowest values in its center; maximum values are near the old gold mines along the periphery. Because it could not form bonds in crystallizing minerals, the gold was concentrated in the residual fluids of the magma and was finally deposited in quartz veins at the edge of the stock. The gold in the minerals is probably entrapped as uncharged gold atoms; the amount in a given mineral was determined by the structure of the mineral and concentration of gold in the magma at the time that mineral crystallized.—D.B.V.

10720 **Manten, A. A.** Microfossil-like objects in meteorites: Earth-Sci. Rev., v. 1, no. 4, p. 337-341, illus., 1966.

A review is given of publications representing five years' work advocating or opposing the suggestion by Claus and Nagy (1961) that "organized" elements are present in carbonaceous meteorites which represent remains of extraterrestrial life. A list of 33 references is included.—V.S.N.

10845 **Markowitz, William.** Astronomical programs for the study of continental drift, *in* Internat. symposium on recent crustal movement, 2d, Aulanko, Finland, 1965, Proc.: Acad. Sci. Fennicae Annales, ser. A-III, no. 90, p. 241-245, table, 1966.

Past astronomical observations are not suitable for determining whether continental drift has occurred. Systematic errors, leading to spurious drift rates of the order of 50 milliseconds per century are indicated. It is necessary that errors in position and proper motions of stars be eliminated by concurrent observation of the same stars by pairs of stations to determine within small limits whether or not continental drift exists.—Author's abstract

00820 **Marsh, R. E.; Shoemaker, D. P.** Arthur Lindo Patterson, 1902-1966: Acta Cryst., v. 22, pt. 5, p. 749-750, portrait, 1967.

**Marsh, Stanley P.** *See* McQueen, Robert G. 00773

10726 **Marshall, K. M. W.** Provisional map showing economic geology of Trinidad: [Port of Spain] Trinidad Ministry of Petroleum and Mines, scale 1:100,000, 1966.

10727 **Marshall, K. M. W.** Hydrogeological map of Trinidad: [Port of Spain] Trinidad Ministry of Petroleum and Mines, scale 1:100,000, 1966.

**Mase, George E.** *See* Shoua, Ezra D. 10922

10923 **Mase, George E.; Shoua, Ezra D.** Effects of confining pressure on polycrystalline rock behavior analysed by rheological theory—Pt. 2, Application and predictions [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 743–747, illus., 1966.

In this investigation, the rock behavior is simulated by a rheological model composed of two independent systems, one representing the crystal properties and the second the properties of the grain boundaries. This unique arrangement offers a means whereby in the mathematical analysis the separate contributions of the crystals and the grain boundaries are correlated to the degree of confinement. This rheological description of rock behavior not only yields results in good agreement with existing experimental data but furthermore provides a basis for understanding the variation of physical constants with changes in confining pressure.—Authors' summary

00746 **Matthews, Vincent.** Use of the Iredell loam as an aid in locating unmapped gabbro-norite bodies in Georgia [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 87, 1967.

10819 **Mattson, Peter H.** Geological characteristics of Puerto Rico, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 124–138, illus., table, 1966.

Major geologic features of Puerto Rico are: a central volcanic belt (Albian-Eocene) intruded by quartz monzonite and granodiorite plutons and flanked by Oligocene and younger clastics and carbonates, and a serpentinite basement in the southwestern corner of the island. Lack of detrital quartz, presence of serpentinite, and location of the island with no record of a nearby continental land mass suggest an oceanic crust. It is suggested that partial fusion of mantle peridotite produced initial volcanic liquids and successive refusions (Cretaceous) of these volcanic piles formed younger andesitic rocks. Two zones of west-trending left-lateral transcurrent faults cross the island; pre-Oligocene compressional forces were perhaps related to these zones; vertical movements have been dominant since Eocene.—B.S.H.

10834 **Maurer, William C.** Shear failure of rock under axial and hydrostatic pressure [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 337–341, illus., table, 1966.

Shear strengths measured on several rock types using axial pressure revealed shear strength–normal stress relations which correlate closely with Mohr envelopes from triaxial tests; shear strengths were slightly higher than in triaxial tests, possibly a result of the fact that in shear tests fractures are forced along definite planes but in triaxial tests choose the weakest paths. Hydrostatic fluid pressure produced much smaller increases in shear strength than axial pressure. Friction along fracture surfaces decreases with fracture displacement, reaching a steady-state value about 0.01 to 0.02 inches displacement; friction increases as the 0.4 to 0.8 power of contact pressure, and the coefficient of friction decreases from about 1.8 to 0.8 as the contact pressure is raised from about 2,000 psi to the uniaxial compressive strength of the rock.—V.S.N.

**McAlester, A. L.** *See* Stehli, F. G. 00693

10883 **McAnerney, J. M.** Terrain interpretation from radar imagery, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 731–750, illus., table, 1966.

The interpretation of physiographic and cultural terrain features from imagery obtained with high resolution, side-looking radar alone is demonstrated. Two areas [Pierre, S. D., Winona, Minn.] in the central United States are used as examples.

Through a deductive process similar to that used in interpretation of visual aerial photography, it is shown that a trained interpreter can describe the physiography, geology and soil of a populated region. The discussion includes an example of measuring terrain relief from radar shadows.—Author's abstract

10873 **McBirney, A. R.; Weill, D. F.** Rhyolite magmas of Central America: Bull. Volcanol., v. 29, p. 435–446, illus., 1966.

Two rhyolites are found in Central America in recent obsidian domes in the basalt–rhyolite association of southeastern Guatemala, and in late Tertiary ignimbrites in Honduras and adjacent parts of Nicaragua. Both are on the inner side of the main volcanic axis in a region underlain by older metamorphic and plutonic rocks. Melting experiments, together with chemical, isotopic, and volumetric relations, indicate that the ignimbrites are products of partial fusion of the basement series, while the obsidians have differed from more basic magmas by a process other than crystal fractionation.—D.B.V.

10696 **McCamy, K.; Meyer, R. P.** Crustal results of fixed multiple shots in the Mississippi Embayment, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 370–381, illus., table, 1966.

A crustal profile using five fixed shot points in the Mississippi River near Cape Girardeau, Missouri, was shot in the summer of 1962. Recordings were made along a line to Little Rock, Ark., with dense spacing to 250 km and a maximum range of 420 km; this work reversed the profile reported earlier by Steinhart and Meyer. Shots from all five of the fixed shot points were recorded at each site, permitting fixed-array analysis of the profile. The reversed solution shows an essentially flat M-discontinuity at 45-km depth, with an 8.1-kmps mantle, overlain by a 7.4-kmps layer 15 km thick. The upper crust (0–29 km) is characterized by gentle dips to the southwest and rather high velocities, 6.2 and 6.4 kmps.—Authors' abstract

**McCary, Charles E. L.** *See* Wilson, Charles W., Jr. 00824

00825 **McCary, Charles E. L.** Mineral resources summary of the Aspen Hill quadrangle, Tennessee (including the Tennessee portion of the Salem quadrangle, Alabama–Tennessee): Nashville, Tenn., Tennessee Div. Geology, 8 p., 1967.

Mineral resources that have been mined in the Aspen Hill quadrangle are limestone and gravel. Six exposed limestone formations are thick enough to supply commercial quantities of stone; the Carters and Bigby–Cannon Limestones, and to some extent the Catheys and Leipers Formations are most suitable for general purposes. Gravel deposits are present in alluvium along flood plains, maximum thickness being about 30 feet. Potential resources are phosphate and chert. This text accompanies Tennessee Div. Geology Geol. Map GM 59-SE (1967) by C. W. Wilson, Jr., and others (cited separately).—M.C.M.

00806 **McClain, W. C.; Bradshaw, R. L.** Stress redistribution in room and pillar salt mines: Internat. Jour. Rock Mechanics and Mining Sci., v. 4, no. 2, p. 245–255, illus., 1967.

In newly excavated rooms in the Lyons mine at Lyons, Kansas, at a higher stratigraphic position than surrounding older workings, it was possible to measure rock deformations as the working face passed directly over instrumented boreholes. In order to obtain sufficient rock mechanics data to design a disposal facility for radioactive wastes for any desired degree of room closure, a large number of different measuring instruments were used in the experimental area. Three different borehole gage types showed a degree of correspondence qualitatively, but no quantitative conclusion could be drawn from any of the instruments. In general, results confirmed the presence of an abutment pressure in the floor moving along with the advancing face.—V.S.N.

**McCoy, Floyd.** *See* Malahoff, Alexander. 00627

00854 **McCoy, Henry J.** Ground water in the Immokalee area, Collier County, Florida: Florida Geol. Survey Inf. Circ. 51, 31 p., illus., table, 1967.

Potable ground water in the Immokalee area is available at depths ranging from 20 to 300 feet below the surface; this subsurface section consisting of quartz sand, marl, shells, and consolidated to semi-consolidated limestone, is essentially a single unconfined aquifer. Principal chemical constituents of the ground water are calcium and bicarbonate. Objectionable constituents include small amounts of iron and hydrogen sulfide. Shallow coarse sand and gravel beds west and northwest of Immokalee contain the best quality ground water and appear to be the best source for municipal supplies.—M.S.T.

00799 **McDonald, J. A.** Liquid immiscibility in chromitite seam formation—A reply [to discussion by E. D. Jackson, 1966, of paper by McDonald, 1965]: Econ. Geology, v. 62, no. 2, p. 288–292, 1967.

Jackson (ibid., v. 61, p. 777–780, 1966) incorrectly equates the silicate inclusions described by McDonald from the Bushveld Complex with the "type 2" inclusions Jackson has described from the Stillwater Complex, and his criticisms based on this premise are not valid. Experimental studies on relatively simple systems do not preclude the existence of a spinel-rich immiscible liquid in a more complex natural system.—W.S.W.

00831 **McGrew, Laura W.** Geologic map of the Natwick SW quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-623, scale 1:24,000, section, 1967.

00832 **McGrew, Laura W.** Geologic map of the Richeau Hills quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-625, scale 1:24,000, section, 1967.

00833 **McGrew, Laura W.** Geologic map of the Wheatland NE quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-628, scale 1:24,000, 1967.

00889 **McGugan, Alan.** Permian stratigraphy, Peace River area, northeast British Columbia: Bull. Canadian Petroleum Geology, v. 15, no. 1, p. 82–90, illus., 1967.

A completely exposed sequence of Permian rocks on Mount Greene is proposed as a reference section for the Peace River area. The rocks, which are assigned to the Isbel Group, consist of two formations and unconformably overlie Pennsylvanian strata. The lower formation, a 158-ft unit of thin-bedded phosphatic siltstone and siltstone-carbonate beds with layers and nodules of chert, is informally named Mount Greene beds. The upper unit Ranger Canyon Formation, consists of 72 feet of thin chert beds.—W.A.C.

**McIntire, William G.** *See* Rigby, J. Keith. 00647

00666 **McMahon, Beverly E.; Strangway, David W.** Kiaman magnetic interval in the western United States: Science, v. 155, no. 3765, p. 1012–1013, illus., 1967.

Late-Paleozoic red beds in the western United States indicate that Earth's magnetic field was reversed for a period of the order of $50 \times 10^6$ years. Agreement with similar results from igneous rocks in Australia indicates that the long period of reversal in the magnetic field was worldwide. The rocks on the two continents appear to be essentially equivalent in time, suggesting early magnetization of the red beds. The time spectrum of reversals is irregular in geologic time, but present evidence suggests reversals characterized by time scales of $10^4$ or $10^5$, $10^6$, and $50 \times 10^6$ years. The $50 \times 10^6$ year period of steady reversed field of the late Paleozoic is termed the Kiaman magnetic interval.—D.B.V.

00689 **McManus, Dean A.** Physiography of Cobb and Gorda Rises, northeast Pacific Ocean: Geol. Soc. America Bull., v. 78, no. 4, p. 527–546, illus., table, 1967.

Cobb and Gorda Rises, previously interpreted as northern extensions of the East Pacific Rise, are reinterpreted as a rejuvenated segment of an older arcuate rise or an auxiliary ridge associated with the Mendocino Fracture Zone. The rises, separated by a transverse fracture zone, have a crest province with a median valley, a flank province, and a transition province. Gorda Rise has the better developed median valley and associated positive magnetic anomaly. They show greater similarity to the mid-Atlantic Ridge than to the East Pacific Rise.—R.G.Y.

10769 **McMath, Vernon E.** Geology of the Taylorsville area, northern Sierra Nevada, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 173–183, illus., 1966.

A general description of the regional structure and metamorphism is given for the area, together with a detailed stratigraphic correlation of Paleozoic and Mesozoic units as revised and interpreted by the author and correlated with the earlier stratigraphic work of Turner (1897) and Diller (1908).—M.S.T.

00773 **McQueen, Robert G.; Jamieson, John C.; Marsh, Stanley P.** Shock wave compression and X-ray studies of titanium dioxide: Science, v. 155, no. 3768, p. 1401–1404, illus., tables, 1967.

The Hugoniot of the rutile phase of $TiO_2$ has been determined to 1.25 megabars, and data show the existence of a phase change at about 0.33 megabar. The volume decrease associated with this transformation appears to be about 21 percent. Rutile, when recovered from shock-loading in excess of the transformation pressure, is found to be irreversibly transformed to the orthorhombic lead dioxide structure (a distortion of the fluorite structure) with parameters a, 4.529; b, 5.464; and c, 4.905 A and a calculated density of 4.374 g per $cm^3$. The new phase reverts to rutile above 450°C. It is suggested that the new phase may be another diagnostic indicator of meteorite impact on the Earth's surface.—*from* Authors' abstract

10906 **McWilliams, J. R.** The role of microstructure in the physical properties of rock, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 175–189, illus., 1966.

The paper describes an approach to understanding rock properties through study of their relation to the microstructure of the rock. Petrofabric analyses of rock specimens, subjected to various physical property tests, have shown a strong correlation among several properties and some of the microstructural features. The equipment and techniques being used in these rock physics studies are discussed. As an example of this work, the description and results of an experimental study of anisotropism in Salisbury granite are given. There was a strong correlation among the direction of maximum and minimum sonic velocity, preferred direction of failure, and a number of microstructural features, such as defect structures and grain orientation.—*from* Author's abstract

10759 **Meade, Buford K.; Small, James B.** Current and recent movement on the San Andreas fault, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 385–391, illus., 1966.

A system of survey networks, established at various places along major faults, has been reobserved at periodic intervals; horizontal movement has been disclosed by changes in the final coordinates at each station in the net. In each area along the San Andreas fault where movement has been observed, the direction of movement has been right lateral, that is, a line between the points has rotated in a clockwise direction. Some vertical movement has been detected as a result of releveling of the Coast and Geodetic Survey's basic vertical control net. Much of this vertical movement is attributed to subsidence due to removal of underground water, oil, and gas. A few areas of bedrock show a small amount of uplift.—M.S.T.

10878 **Meade, Buford K.; Lilly, J. E.; Medina Peralta, Manuel; Smith, Stewart W.; Small, James B.** Report of the Sub-Commission on Recent Crustal Movements in North America, *in* Internat. symposium on recent crustal movement, 2d, Aulanko,

Finland, 1965, Proc.: Acad. Sci. Fennicae Annales, ser. A–III, no. 90, p. 247–266, illus., tables, 1966.

The five parts of this report summarize studies on crustal movements in Canada (Lilly), the Mexican program (Medina Peralta), the San Andreas fault system (Smith), vertical crustal movements in the United States (Small), and horizontal crustal movements in the United States (Meade).—D.B.V.

**Medina Peralta, Manuel.** *See* Meade, Buford K. 10878

10901 **Meier, Mark F.; Alexander, Robert H.; Campbell, William J.** Multispectral sensing tests at South Cascade Glacier, Washington, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 145–159, illus., table, 1966.

Airborne remote sensing tests at South Cascade Glacier, Washington, to determine the potential of obtaining glaciological data, indicate that near-infrared is the most effective in distinguishing snow from ice and old firn, and short wavelength visable light to distinguish moraine from ice. Textural patterns in the snow-covered area are detectable at all photographic wavelengths but exposure is critical at short wavelengths and detail will be lost in shadowed areas at long wavelengths. Wetness contrasts were emphasized by the infrared. Color-infrared film shows more detail than color or individual band photographs, both on glacier and moraines. Thermal-infrared detected lake and moraine thermal patterns. Crevassed areas, moraines, and other linear structures show up clearly on radar images. Gross textural differences between glacier and land are apparent even when snow covered.—*from* Authors' abstract

10672 **Mereu, R. F.** A polarization study of *P* head waves from the Lake Superior experiment, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 205–217, illus., tables, 1966.

A theoretical and an experimental study was made on apparent angles of emergence of $P_2$ and $P_n$ waves arriving at a fixed recording station from a series of moving shots. In the first, crustal models were chosen in which $P_2$ and $P_n$ were given values of 6.68 and 8.10 kmps obtained from a time term study in the 1963 Lake Superior experiment. Elastic parameters, including effects of near surface layering were incorporated in the $P_1$ layer. In the experimental study, a three component array of seismometers was placed at Marathon, Ontario, to record the 1963 Lake Superior shots and at Wawa, Ontario, to record the 1964 experiment. Observations confirmed the prediction from the theoretical study that an 8° to 12° difference should be expected in apparent angles of emergence between the waves, and also showed the presence of lateral inhomogeneities in crust near Marathon.—*from* Author's abstract

10690 **Mereu, R. F.** An iterative method for solving the time-term equations, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 495–497, tables, 1966.

In a seismic refraction survey involving m stations and n shots, the number of time terms that can be obtained is m+n. It is shown here how normal equations for solution of these time terms can be modified in such a way that an iterative process can be applied to the solution. Its advantage over other methods is that it does not tax the storage capacity of the computer. All information contained in the coefficient matrix can now be stored in mn+(m+n) locations. This is a very significant reduction, and if necessary a system of coding elements into storage can be employed that reduces the number still further to 1/8 mn+(m+n). The technique is easily applicable to cases where more than 300 time terms would have to be determined simultaneously.—*from* Author's abstract

00730 **Merkle, A. B.; Slaughter, M.** The crystal structure of heulandite (Ca, $Na_2$)$[Al_2Si_7O_{18}]\cdot 6H_2O$: Am. Mineralogist, v. 52, nos. 1–2, p. 273–276, illus., table, 1967.

An unrefined structure has been determined for heulandite from three-dimensional equi-inclination Weissenberg data; it differs significantly from that proposed by Ventriglia (1955) and shows strong similarities with other closely related members of the zeolite family. Parameters of the monoclinic cell are: a=17.73, b=17.82, c=7.43A, and $\beta$=116°20′. Three-dimensional Patterson maps indicated space group Cm and also led to determination of the remaining framework atoms. Unrefined atomic coordinates are tabulated.—V.S.N.

**Mero, John L.** *See* Wilson, Thomas A. 10736

00659 **Merritt, Clifford A.** Elmer Lawrence Lucas (1898-1966): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 4, p. 624, portrait, 1967.

**Meyer, R. P.** *See* Bednarek, A. R. 10675

**Meyer, R. P.** *See* McCamy, K. 10696

**Meyer, R. P.** *See* Cohen, T. J. 10702

**Meyer, Robert.** *See* Shima, Etsuzo. 10678

**Meyer, William L.** *See* Hazen, Scott W., Jr. 10855

00920 **Meyn, H. D.** Parkin township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 400, scale 1 in. to 1/4 mi., text, 1967.

Main rock units in Parkin township in order of decreasing age are: metavolcanics, granitic rocks, Huronian metasediments (Mississagi, Bruce, Espanola, Serpent, Gowganda, and Lorrain Formations), intrusive rocks, nickel irruptive, and late mafic intrusives. Metavolcanic rocks have been folded, faulted and sheared; granite is foliated and grades into gneisses and migmatites; most Huronian metasediments have been folded and faulted. From 1952-54 nickel-copper sulfide was produced from two ore bodies. Extensive exploration has been carried out for uranium, nickel, copper, lead, zinc, gold, silver, and limestone.—M.C.M.

00921 **Meyn, H. D.** Hutton township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 399, scale 1 in. to 1/4 mi., text, 1967.

Main rock units in Hutton township in order of decreasing age are: metavolcanics, granitic rocks, Huronian metasediments (Mississagi, Bruce, Espanola, Serpent, and Gowganda Formations), and late mafic intrusives. Metavolcanic rocks have been folded, faulted, and sheared; granite is commonly foliated and grades into gneisses and migmatites; Huronian metasediments have been folded and block faulted; no large fold structures were noted. Pelletized iron ore at Moose Mountain mine is produced from lenses of taconite. Minor sulfide mineralization was observed, exploration has not revealed uranium material of ore grade, and the Espanola Limestone has been explored for cement and flux purposes.—M.C.M.

**Milici, Robert C.** *See* Swingle, George D. 00938

10884 **Miller, Lee D.** Location of anomalously hot earth with infrared imagery in Yellowstone National Park, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 751-769, illus., table, 1966.

Infrared imagery of Yellowstone National Park acquired under a program described in the "Third Symposium on Remote Sensing of Environment" was used on the ground in the Park to locate several anomalously hot earth areas. The areas sought out were manifested at the surface only as hot earth and not as hot water or steam. Only one of the approximately dozen such areas encountered had been previously specifically noted by individuals frequenting these areas of the Park. Interactions between the anomalously hot earth and the surrounding vegetation including tree cover will also be noted.—Author's abstract

10781 **Monroe, Watson H.** Formation of tropical karst topography by limestone solution and reprecipitation: Caribbean Jour. Sci., v. 6, nos. 1–2, p. 1–7, illus., 1966.

In the tropics beneath a cover of soil, the limestone is dissolved rapidly to form deep dolines or cockpits, as the calcium carbonate is carried away in the ground water. In pure limestone not protected by soil, the solutions do not have time to drain from the rock before they are evaporated. As a result, calcium carbonate is precipitated nearly in place to form an indurated capping very resistant to erosion. These effects of solution and induration, largely dependent on soil cover and on purity of the limestone, produce a rugged landscape of a kind well exemplified in northern Puerto Rico.—Author's abstract

00789 **Monty, Claude L. V.** Distribution and structure of Recent stromatolitic algal mats, eastern Andros Island, Bahamas: Soc. Géol. Belgique Annales (1966–67), v. 90, Bull. 3, p. B55–B100, illus., 1967.

Various types of modern stromatolitic structures are described from supratidal, intertidal and infralittoral settings of eastern Andros Island, Bahamas, primarily as an aid to interpretation of fossil stromatolites. Their microstructure is interpreted from study of thin sections and related to environmental conditions.—V.S.N.

00795 **Moorbath, S.; Hurley, P. M.; Fairbairn, H. W.** Evidence for the origin and age of some mineralized Laramide intrusives in the southwestern United States from strontium isotope and rubidium–strontium measurements: Econ. Geology, v. 62, no. 2, p. 228–236, tables, 1967.

Initial Sr–87/Sr–86 ratios for Laramide granitoid intrusives associated with mineral deposits are in the range 0.705–0.711, which is much lower than the ratios in Colorado Precambrian basement; these ratios for basement are estimated to have been in the range 0.76–0.80 in Laramide time. The Laramide intrusives, therefore, cannot have been derived primarily from partial or complete fusion of average Precambrian gneiss, but came from a more deep-seated source like the source regions of basalt. Scottish granites with high initial Sr–87/Sr–86 ratios "are virtually devoid of mineralization."—W.S.W.

10794 **Moore, Carleton B.; Lewis, Charles F.** The distribution of total carbon content in enstatite chondrites: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 376–378, table, 1966.

Total carbon content has been determined on 13 of the 15 recognized enstatite chondrites; data are tabulated. Abundances range from 0.056 wt percent in Khaipur to 0.56 wt percent in Kota Kota. The distribution does not indicate a natural division of the enstatite chondrites into two subgroups as suggested by Mason (1966).—V.S.N.

10859 **Moore, David Gillis.** Structure, litho-orogenic units, and postorogenic basin fill by reflection profiling—California continental borderland: San Diego, Calif., U.S. Navy Electronics Lab., 151 p., illus., table, 1966.

The faulted continental shelf off southern California and northern Baja California contains 18 major basins, 20 to 80 nautical miles long and 5 to 22 miles wide, with depths over 1,600 fathoms and distance to sediment supply 0 to 110 miles. The most profound event in the geologic history was the post-Triassic, pre-Cretaceous diastrophism, plutonic intrusion, and metamorphism. Preorogenic sedimentation was in a simple broad basin, whereas for postorogenic deposits turbidity currents were of paramount importance. In the proposed transportation–deposition system, Pleistocene stream discharge was the major contributor of sediment; feeder submarine canyons headed in near shore, delta front, or active estuary; and distributaries funneled turbid layers of fine particles. Principles and techniques of continuous-reflection profiling are given in an appendix.—G.D.C.

10871 **Moore, J. G.** Gravity slide origin of rift zones of some Hawaiian volcanoes: Bull. Volcanol., v. 29, p. 719–720, 1966.

It is shown that the east-trending east rift zone of Kilauea dips south and bounds a large segment of the volcano which is sliding down the steep southern flank. Tensional cracks at the head of this slide tap the shallow central reservoir at a few kilometers depth. The resulting dikes may feed eruptive fissures in the tensional zone at the head of the slide, or may pierce the hanging wall of the rift zone to feed the cinder cones. Likewise, shallow collapse into the rift zone on the north produces narrow grabens, whereas deeper collapse farther south produces circular pit craters.—D.B.V.

**Moore, J. M., Jr.** *See* Hounslow, A. W. 00910

**Morey, G. W.** *See* Rowe, J. J. 00842

**Moston, R. P.** *See* Johnson, A. I. 10713

00630 **Mueller, Robert F.** Stability of metamorphic amphiboles—The tremolite-ferroactinolite series, a discussion [of paper by E. Hellner and K. Schürmann, 1966]: Jour. Geology, v. 75, no. 2, p. 234–236, 1967.

The author criticizes the paper of Hellner and Schürmann (ibid., v. 74, p. 322–331, 1966) on the following points: the fugacity of oxygen was not closely controlled; $P_{water}$ and $P_{carbon\ dioxide}$ were not known; the reactions were not reversed and so equilibrium may not have been attained; and the discussion concerning stability of talc, calcite, quartz, magnetite and hematite below 648°K neglects the effect of fugacity of oxygen.—F.B.

**Mueller, William M.** *See* Mallett, Gavin R. 10925

**Mullineaux, Donal R.** *See* Crandell, Dwight R. 00696

10861 **Murata, K. J.; Dondoli, C.; Saenz, R.** The 1963–65 eruption of Irazú Volcano, Costa Rica—The period of March 1963 to October 1964: Bull. Volcanol., v. 29, p. 765–793, illus., tables, 1966.

The 1963–65 eruption of Irazú, like its other eruptions during historic times, produced only ash and other pyroclastics without lava. After the initial outbreak on March 13, 1963, which started with a series of great explosions, activity settled down to alternating periods of explosive eruptions and quiet emission of steam. The climax of eruption occurred in December 1963 and January 1964, when magma rose to within 100 m of the lip of the vent and ash and incandescent scoria were erupted voluminously. Precise leveling revealed that the upper part of the volcano upheaved as much as 11 cm above 1949 levels then subsided to approximately the 1949 configuration. The ash deposits are discussed.—D.B.V.

00877 **Murphy, Michael A.** The Aptian-Cenomanian members of the ammonite genus *Tetragonites*: California Univ. Pubs. Geol. Sci. 69, 78 p., illus., tables, 1967.

*Tetragonites* evolved during the late Aptian from *Eotetragonites*. In the Albian it differentiated into three groups characterized by *T. timotheanus* (Pictet), *T. rectangularis* Wiedmann, and *T. kitchini* (Krenkel). The *T. rectangularis* group gives rise to most of the Upper Cretaceous members of the subfamily Tetragonitinae. Species of *Tetragonites* are useful for correlation of middle Cretaceous stages because of their short stratigraphic ranges. Newly described taxa from North America are: *T. hulenensis n.sp., T. lecontei n.sp., T. jonesi n.sp., and T. rectangularis alaskaensis n.subsp., and Eotetragonites gardneri n.sp.* Two new species from Europe and one from Madagascar are also described.—W.O.A.

10921 **Murphy, Vincent J.; Holt, Richard J.** Seismic velocities and elastic moduli measurements, Mount Holyoke Range, Massachusetts, U.S.A. [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 711–712, tables, 1966.

Seismic velocities, measured in a deep borehole of the Mt. Holyoke Range, Massachusetts, U.S.A., are relatively high values. Elastic moduli determinations

based on the velocity values are in good agreement with laboratory measurements. [Data are tabulated.]—Authors' abstract

**Nagaraja Rao, N.** *See* Finney, J. J. 00738

10809 **Nagata, Takesi.** A review of recent studies on conductivity anomalies along continental margins, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 418-429, illus., 1966.

The disturbance vector of geomagnetic variation of a duration from several minutes to several hours along some continental margins (e.g. the Australia, Antarctica, and California coasts and Japanese islands) has an anomalous behaviour referred to as the coastal effect. The coastal effect is attributed to a difference in electric conductivity of the upper mantle under the oceans and under the continents; either the thickness of the non-conductive uppermost part of the mantle is much thinner under the oceans than under the continents, or the conductivity of the upper mantle is much higher under the oceans than under the continents.—Author's abstract

**Narahari Achar, B. N.** *See* Brindley, G. W. 00707

**Nation, Joseph B.** *See* Hales, Anton L. 10677

**Naughton, J. J.** *See* Funkhouser, J. G. 10863

**Needham, H. D.** *See* Conolly, J. R. 00631

**Nees, W. L.** *See* Lystrom, D. J. 00822

10838 **Neff, T. L.** Equipment for measuring pressure in rock specimens under triaxial load, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 3-17, illus.; reply to discussion by B. W. Paulding, Jr., p. 17-18, 1966.

This paper deals with equipment development, procedural details, and pilot tests of larger specimens of intermediate-quality rock, and rock containing joint systems and weakness planes. The effect of pore-pressure buildup during loading and its graphical representation, that is, the vector curve as employed in soil mechanics, is considered. Work to date indicates that in an undrained triaxial test the pore pressure rises to a peak value at "yielding" of the specimen and then falls off to some lower value at failure. Peak values and final values vary widely for different rock types. The vector curve depicts quite clearly the results of the undrained triaxial test.—Author's abstract

10914 **Nelson, S. J.; Johnson, R. D.** Geology of Hudson Bay basin: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 520-578, illus., 1966.

The Hudson Bay basin underlies most of Hudson Bay. The stratigraphic succession consists of rocks of Ordovician, Silurian, Devonian and questionable Cretaceous age. The thickest section is toward the center of Hudson Bay where between 6,000 and 10,000 feet of sedimentary rocks have been interpreted by geophysical surveys. Silurian rocks on Southampton, Coats, and Mansel Islands in Hudson Bay contain a sequence of oil shale at least 50 feet thick. Paleozoic formations of the area appear to contain favorable reservoir rocks for petroleum.—J.R.G.

00722 **Nester, J. F.; Schroeder, J. B.** Growth of synthetic calcite single crystals: Am. Mineralogist, v. 52, nos. 1-2, p. 276-280, illus., 1967.

Calcite crystals up to 1 cm×1 cm×0.1 cm free from inclusions were obtained by slowly cooling a 1:1 mole ratio of $CaCO_3$ and $Li_2CO_3$ from 800 to 650°C in a gold crucible under a flowing $CO_2$ atmosphere. Separation of the calcite from the flux is still a problem.—E.H.R.

**Newell, M. F.** *See* Stern, T. W. 10793

**Nguyen, D.** *See* Ladanyi, B. 10841

10789 **Ninkovich, Dragoslav; Opdyke, Neil; Heezen, Bruce C.; Foster, John H.** Paleomagnetic stratigraphy, rates of deposition and tephrachronology in North Pacific deep-sea sediments: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 476–492, illus., tables, 1966.

The paleomagnetic stratigraphy of 12 North Pacific sediment cores has been used to date volcanic eruptions and to determine rates of deposition of pelagic sediment. Four cores penetrated sediments deposited before the last reversal of the Earth's magnetic field (0.7 m.y.): one to the Gauss series, two to the Olduvai event, and one to middle Matuyama series. Rates of deposition vary from >2 cm/1000 yr east of the Asiatic continent to >0.8 cm/1000 yr in mid-Pacific. Assuming continuous deposition, the length of the Jaramillo event is 50,000 yr and the Olduvai, 14,000 yr. The time during which the Earth's dipole field was reduced during reversals is approximately 20,000 yr. In one core the Olduvai event is split; this may be the Gilsa event. Brown volcanic ash in three cores originated in an eruption 1.2 m.y. ago near the Andreanof Islands.—*from* Authors' abstract

00705 **Noble, Donald C.; Smith, Vertie C.; Peck, Lee C.** Loss of halogens from crystallized and glassy silicic volcanic rocks: Geochim. et Cosmochim. Acta, v. 31, no. 2, p. 215–223, illus., tables, 1967.

This paper presents results of 164 F and Cl analyses of silicic welded tuffs and lavas and glass separates. Comparison with the F and Cl contents of crystallized rocks with those of nonhydrated glass and hydrated glassy rocks from the same rock units shows that most of the halogens originally present were lost on crystallization. In some cases significant amounts of halogens may be removed from or added to hydrated glass through prolonged contact with ground water. The original halogen contents of the groundmass of a silicic volcanic rock can be reliably determined only from nonhydrated glass.—D.B.V.

00709 **Noble, Donald C.** Sodium, potassium, and ferrous iron contents of some secondarily hydrated natural silicic glasses: Am. Mineralogist, v. 52, nos. 1–2, p. 280–286, illus., tables, 1967.

Analyses of pairs of hydrated and nonhydrated glasses suggest that in most cases, hydration by the action of ground water will cause loss of sodium and gain of potassium. Continued alteration will progressively remove sodium and may leach potassium. Silica results suggest slight leaching during hydration; total iron remains constant but is significantly oxidized during hydration.—B.C.H.

10915 **Norford, B. S.; Gabrielse, H.; Taylor, G. C.** Stratigraphy of Silurian carbonate rocks of the Rocky Mountains, northern British Columbia: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 504–519, 1966.

Silurian rocks are divided into an eastern, carbonate facies and a western, graptolitic rocks facies. The Nonda Formation is here proposed for rocks of late Llandovery age in the carbonate facies. The type section is described in detail and the faunal assemblages are listed and evaluated. The Nonda Formation is present between the Peace River on the south and the Yukon border on the north, and, in its type area in the Sentinel Range, it unconformably overlies Precambrian rocks and disconformably underlies the McConnell Formation of probable Early Devonian age.—C.A.S.

00893 **Norris, D. K.** Structural analysis of the Queensway folds, Ottawa, Canada: Canadian Jour. Earth Sci., v. 4, no. 2, p. 299–321, illus., 1967.

In layered limestone and shale of the Ottawa Formation are an anticlinal-synclinal pair of parallel, flexural-slip folds with horizontal axes trending northwest, parallel to the surface trace of the Gloucester fault. Five principal fracture subpatterns were caused by at least four geometrically distinct stress fields; the directions at failure coincide with three orthogonal fabric axes, the maximum stress either parallel or perpendicular to the fold axes and to the fault. Slickensides and striae indicate two kinematic patterns: one in the deformation plane from folding motion, the other

at an angle to it, from strike-slip displacement on the fault—each bed free to move relative to the adjacent ones during folding, and each the fundamental structural unit in flexural-slip folding. Model studies support the field data.—G.D.C.

10832 **Norris, D. K.** The mesoscopic fabric of rock masses about some Canadian coal mines [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc. V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 191–198, illus., 1966.

The structural fabric of rocks in coal mines of the eastern Cordillera of Canada has been studied in different thrust plates through large stratigraphic intervals and over large areas to relate fabric to closure of mine cavities. Bedding, joints, cleats, and faults are the principal mesoscopic structures kinematically active in relaxation, sag, and collapse of layered, sedimentary successions in the mines. Data from five localities are considered.—V.S.N.

10903 **Norris, D. K.; Price, R. A.** Middle Cambrian lithostratigraphy of southeastern Canadian Cordillera: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 385–404, illus., 1966.

Cambrian strata in the Flathead–Crowsnest Pass area of Alberta and British Columbia consists of the Flathead, Gordon, Elko, and Windsor Mountain Formations. The quartzitic Flathead Formation rests unconformably on Precambrian Beltian rocks, grading upward into the Gordon Formation which is mostly shale. The Gordon grades upward into the Elko Formation, a cliff-forming gray dolomite. The sequence of limestone and dolomite lying conformably on the Elko is here named Windsor Mountain Formation. All were bevelled by pre-late Middle Devonian erosion toward the northwest. The Cambrian rocks are more closely related to the Cambrian of the southern Alberta Plains and northern Rocky Mountains of Montana than to strata of similar age farther north. These relations suggest that the tectonically positive area, Montania, was inundated during Middle Cambrian.—W.A.C.

**Nushiro, Ikuo.** *See* Akimoto, Syun-Iti. 00675

10757 **Oakeshott, Gordon B.** San Andreas fault in the California Coast Ranges province, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 357–373, illus., 1966.

The author presents a history of the study of the San Andreas fault system, and a summary of its activity, extet, and the geologic formations involved in its movement. A discussion of the origins of the fault system speculates that the beginning of this faulting at the juncture of the ocean basin and continental platform took place in closing Jurassic time, with additional first-order faulting in Late Cretaceous.—M.S.T.

**Oldale, R. N.** *See* Koteff, Carl. 00829

00741 **Olson, Norman K.** Indurated rock units in the Georgia Coastal Plain [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 88, 1967.

**O'Neil, James R.** *See* Pidgeon, R. T. 10725

00726 **Onuma, Kosuke; Yagi, Kenzo.** The system diopside–akermanite–nepheline: Am. Mineralogist, v. 52, nos. 1–2, p. 227–243, illus., tables, 1967.

The pseudobinary system nepheline–akermanite has a pseudoeutectic point at 1210°±5°C and $Ne_{67}Ak_{33}$. Below the subsolidus temperatures forsterite appears and coexists with nepheline and melilite. The pseudoternary system has two piercing points: (1) One, at 1212°±5°C and $Di_{55}Ak_6Ne_{39}$, shows liquid coexisting with forsterite, melilite, and diopside; (2) the other, at 1169°±5°C and $Di_{38}Ak_3Ne_{59}$, shows forsterite, nepheline, and melilite coexisting with liquid. These two points are univariant and the crystallization moves towards the invariant point within the system $NaAlSiO_4$–CaO–MgO–$SiO_2$ at about 1135°C.—*from* Authors' abstract

**Opdyke, Neil.** *See* Ninkovich, Dragoslav, 10789

00711 **Orville, Philip M.** Unit cell parameters of the microcline–low albite and the sanidine–high albite solid solution series: Am. Mineralogist, v. 52, nos. 1–2, p. 55–86, illus., tables, 1967.

Eleven compositions in the microcline low albite solid solution were produced by dry homogenization at 900°C of mixtures of Ab rich and Or rich end members produced from a natural "maximum microcline" by cation exchange with molten alkali chlorides at 900°C. Twenty compositions in the sanidine high albite solid solution were crystallized from glasses under hydrothermal conditions. The volume curves for both feldspar series show positive volumes of mixing. The triclinic to monoclinic symmetry transformation in the sanidine high albite solid solution occurs at 43.5±2.0 mole percent Or at room temperature.—*from* Author's abstract

**Ostenso, Ned A.** *See* Wold, Richard J. 10710

00888 **Ostic, R. G.; Russell, R. D.; Stanton, R. L.** Additional measurements of the isotopic composition of lead from stratiform deposits: Canadian Jour. Earth Sci., v. 4, no. 2, p. 245–269, illus., tables, 1967.

In the study of apparent correlation between lead isotope abundance and features of deposits in which lead is found, new and precise analyses have been made on 55 galena samples, mostly from Australasian ore deposits classified as stratiform. Certain related vein leads and one analysis of volcanic contunnite are included. There is new evidence that all leads began their isotopic evolution in a unique primary system with restricted spatial variation in ratios U/Pb and Th/Pb. Certain stratiform leads approach more closely in isotopic composition the products of the primary system than do vein leads, in many of which crustal histories modified isotopic ratios. The differences shown in the precise analyses presented are significant and important. Novel aspects of the experimental technique are discussed.—G.D.C.

**Overstreet, W. C.** *See* Theobald, P. K., Jr. 00635

10750 **Page, Ben M.** Geology of the Coast Ranges of California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 255–276, illus., tables, 1966.

A marked feature of the Coast Range province is the presence of two entirely different core complexes, one being a Jurassic–Cretaceous eugeosynclinal assemblage—Franciscan rocks—the other Early(?) Cretaceous granitic intrusives and older metamorphic rocks. The two unrelated core complexes lie side by side, separated by large faults. Four orogenic events are particularly important: (1) Early Cretaceous orogeny, marked by intrusion of granitic–metamorphic plutons, (2) presumed early Tertiary thrusting, which brought "normal" upper Jurassic–Cretaceous sediments into juxtaposition with quasi contemporary eugeosynclinal Franciscan rocks, (3) prolonged Cenozoic strike–slip faulting along the San Andreas system, and (4) late Pliocene and Pleistocene folding and faulting.—M.S.T.

**Page, R. W.** *See* Waananen, A. O. 00642

10683 **Pakiser, L. C.; Robinson, Rhoda.** Composition of the continental crust as estimated from seismic observations, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 620–626, illus., tables, 1966.

The average composition of the continental crust is more mafic than has hitherto been supposed. The conterminous United States can be divided, on the basis of seismic structure, into 10 regions. The seven western and three eastern regions can be termed western and eastern superprovinces. Seismic studies show that the crust is thinner and more silicic in tectonically active regions (western superprovince—average crustal thickness 34 km) than in stable regions (eastern superprovince—average crustal thickness 44 km). Mafic rocks are estimated to average 55 percent

of the continental crust; 45 percent in the western and 59 percent in the eastern superprovince. These results express quantitatively the ideas expressed qualitatively by Pakiser and Zietz. The computations of percentages of major oxides in the crust associate seismic velocities with rock compositions.—Authors' abstract

**Pakiser, L. C.** *See* Hill, D. P. 10685

**Palmer, Raleigh A.** *See* Swingle, George D. 00938

00715 **Pamenter, C. B.** New magnetometer has high accuracy: Canadian Petroleum, v. 8, no. 1, p. 16, illus., 1967.

A new geomagnetic gradiometer can make undistorted magnetic measurements of 0.01 gamma sensitivity. These measurements are more compatible with computers and unaffected by diurnal changes in the Earth's magnetic field. This should improve computations, give more accurate depth determinations, and provide better outlines of sedimentary structures.—B.S.H.

10904 **Panek, L. A.** Calculation of the average ground-stress components from measurements of the diametral deformation of a drill hole, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 106–132, illus., tables, 1966.

Determining the change of stress in rock based on measurements of the deformation of a drill hole is increasingly popular. This principle is used also to determine existing stresses in a rock medium by cutting free (core drilling) an annulus containing the drill hole. Expressions are derived for calculation of the stress ellipsoid—the three-dimensional change of stress or the existing three-dimensional stress field, as the case may be. These equations show that stress components in three dimensions can be determined by measurements in only two drill holes and yield general principles useful in planning an efficient drilling and measurement program. Procedures are given for calculating the least squares estimates of the stress components and their standard errors, and for evaluating or comparing calculated values by means of standard statistical inferences.—*from* Author's abstract

00843 **Patchen, Douglas G.** Newburg gas development in West Virginia: West Virginia Geol. Survey Circ. 6, 33 p., illus., table, 1967.

Recent deep test wells in west central West Virginia have discovered several areas of gas production from the Upper Silurian Newburg sand. Early deep wells to this sandstone did not find gas in commercial quantities, but modern completion techniques of acidizing and fracturing have greatly increased production. The discovery of Newburg gas in Kanawha County in 1964 has started deep exploration in this area. Production is confined to five areas: southern Kanawha and northern Boone Counties; Union district, Kanawha County; Ripley district, Jackson County; Pocatalico district, Putnam County; and Spring Creek district, Wirt County.—M.S.T.

10707 **Patenaude, Robert W.** A regional aeromagnetic survey of Wisconsin, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 111–126, illus., 1966.

The survey was made with a proton magnetometer at an altitude of 3,000 feet above sea level. Principal flight lines correspond with range lines. Smooth profiles over the western part suggest undisturbed Keweenawan flows in the River Falls syncline area. Data in northwestern Wisconsin show that the Douglas fault cannot extend east beyond central Bayfield County unless at great depth and with small displacement. In the north, large-amplitude anomalies are observed over known areas of unoxidized iron-formation. In the Eau Claire area, anomalies may reflect mafic intrusives. A unique, zoned anomaly in the northeast suggests an alkaline complex. The southeast corner is characterized by high values and steep gradients indicative of mafic igneous rocks beneath the quartzite.—*from* Author's abstract

**Patterson, C. C.** *See* Chow, Tsaihwa J. 10784

**Patterson, J. H.** *See* Brindley, G. W. 00707

**Patterson, J. W.** *See* Lyon, R. J. P. 10886

10825 **Patton, F. D.** Multiple modes of shear failure in rock [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 509–513, illus., table, 1966.

The mechanism of shear failure in rock was investigated by studying over 300 rock slopes in the Rocky Mountains, making laboratory sliding friction tests on rock samples and direct shear tests on simulated rock surfaces, and reviewing the shear strength literature. This paper describes the laboratory shear tests used to provide a theoretical framework for interpreting the shear strength of intact or discontinuous rock having an irregular failure surface. The following conclusions were drawn: 1) failure envelopes for specimens with irregular failure surfaces are curved, 2) changes in the slope of a failure envelope reflect changes in the mode of failure, and 3) changes in the mode of failure are related to the physical properties of the irregularities along the failure surface.—*from* Author's summary

10828 **Paulding, B. W., Jr.; Coates, D. F.** Discussion [of "Capabilities of photoelastic coatings for the study of strain in rocks," by H. J. Pincus], *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 103–104, 1966.

This is a discussion of the conditions of temperature, place, and time under which the use of photoelastic coatings to measure strains in rocks can produce valid, significant results. (See Pincus, ibid., p. 87–102.)—M.S.T.

10836 **Paulding, B. W., Jr.** Techniques used in studying the fracture mechanics of rock, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 73–86, illus., 1966.

Partially broken material was obtained to study the growth of cracks during brittle fracture. In uniaxial compression this was accomplished by placing a simply supported beam in parallel with the rock specimen to limit the advance of the ram when the load-carrying ability of the specimen decreased. Uncertainties associated with straight cylindrical specimens were avoided by using cylinders with a reduced central section. Volumetric strain was computed from two perpendicular strain gages. The onset of crack growth and the work expended against confining pressure were found with the aid of plots of volumetric strain versus stress. Measurements of linear compressibility indicated the predominant direction of crack growth and the increase in porosity.—Author's abstract

10839 **Paulding, B. W., Jr.** Discussion [of "Equipment for measuring pore pressure in rock specimens under triaxial load," by T. L. Neff, 1966], *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 17, 1966.

This is a discussion of a paper (ibid., p. 3–17) which deals with equipment development, procedural details, and pilot tests of large specimens of intermediate-quality rock, and rock containing joint systems and weakness planes. The author observes that during uniaxial and confined compression tests, crack growth and an associated volume increase begins at about half the strength and continues to fracture. The crack growth and associated volumetric strain can be determined by plots of volumetric strain versus deviatoric stress. T. L. Neff, original author, makes a rebuttal to this reply.—M.S.T.

10897 **Paulding, B. W., Jr.** Discussion [of "A loading system for the investigation of the inelastic properties of geologic materials," by H. R. Hardy, Jr., 1966], *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 265, 1966.

This is a discussion of possible minor modifications to the loading system described in the original paper (ibid., p. 232–265).—M.S.T.

10882 **Peake, W. H.; Riegler, R. L.; Schultz, C. H.** The mutual interpretation of active and passive microwave sensor outputs, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 771–777, illus., 1966.

The interpretation of surface characteristics from microwave sensor outputs alone is more effective when data are available from both active (radar) and passive (radiometer) sensors. This is because both outputs are determined by the complete scattering pattern of the surface; of which one aspect (backscatter) is estimated by the radar and another (albedo) is estimated by the radiometer. As examples of the interdependence of active and passive sensor outputs, and their relation to significant surface properties, results are given for a series of measurements, made almost simultaneously with radar and radiometer sensors (at 10 GHz and 35 GHz) on a series of lavas at Mono Craters, Calif. The data from one sensor is used to give a more detailed explanation of the output of the other, and the combined outputs interpreted in terms of measurable surface characteristics.—*from* Authors' abstract

10747 **Peck, Dallas L.; Wahrhaftig, Clyde; Clark, Lorin D.** Field trip—Yosemite Valley and Sierra Nevada batholith, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 487–502, illus., table, 1966.

The focal point of this trip is Yosemite Valley and the excellent exposures of granitic rocks of the Sierra Nevada batholith. From San Francisco the trip passes through Oakland, the Diablo Range, the Great Valley, Tracy, Turlock, Merced River valley, Hornitos, Mariposa, El Portal, to Yosemite Valley, and Mirror Lake. The road log describes interesting geologic features along the way, but only one stop is made outside of Yosemite Valley—to view prebatholithic metamorphic rocks.—M.S.T.

**Peck, Lee C.** *See* Noble, Donald C. 00705

**Pecuil, T. E.** *See* Weaver, Charles E. 00685

**Perkins, G. D.** *See* Slind, O. L. 10910

**Perkins, H. F.** *See* Jinks, D. D. 00745

00667 **Perry, Kenneth, Jr.** Methods of petrologic calculation and the relationship between mineral and bulk chemical composition: Wyoming Univ. Contr. Geology, v. 6, no. 1, p. 5–38, illus., tables, 1967.

Application of equations of mass balance to rock systems, with the requirement that molecular members within each mineral phase be linearly independent, provides a base of classification of minerals according to their molecular members and for computing percents of molecular members from mineral chemical analyses. Methods are described for calculating stoichiometric coefficients for both systems of mass action equations necessary for equilibrium and chemical reactions. Comparison of equations of material balance with those of normative calculation clarifies the difference between mode and norm, and suggests a method for computing compositions of mineral phases of variable composition where less data are known. Algebraic methods show that effect of bulk composition on distribution of major chemical species between coexisting phases can be separated from that of temperature in systems where degree of freedom is greater than two.—*from* Author's abstract

10815 **Peter, George.** Preliminary results of a systematic geophysical survey south of the Alaska Peninsula, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–15, p. 223–237, illus., 1966.

Results of a closely spaced grid survey of the magnetic and gravity fields and the bottom topography are presented for an area between lat 45° and 55° N. and long

155°30′ and 158°30′ W. Three positive magnetic anomaly bands parallel the bathymetric contours in the area of the northeast-trending Aleutian Trench. Based on the anomaly pattern, two major crustal discontinuities are apparent: one at the top of the southern trench walls and the other near the southern edge of the outer ridge. It is suggested that the magnetic anomalies represent fracture zones with associated magnetic minerals. Lack of correlation between magnetic data and gravity data may be attributed to the small increase in density of the area of the inferred fracture zone, limited instrument accuracy, and widely spaced sampling interval. A model of crustal structure in the Aleutian Trench is presented.—*from* Author's abstract

**Peterman, Zell E.** *See* Hedge, Carl E. 00687

00679 **Peterson, Gary L.** Upper Cretaceous stratigraphic discontinuity, northern California and Oregon: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 4, p. 558–568, illus., 1967.

A widespread stratigraphic discontinuity may exist at the base of the upper part of the Hornbrook Formation, the upper part of the Redding Formation, the type Chico Formation, the Guinda and Forbes Formations, and the Gualala and Yager Formations. Rock units below the discontinuity range widely in type and age. Magnitude of the lacuna ranges from very small in some areas to a period or more in other areas. This discontinuity is believed to be related to the "Coast Range orogeny", a Late Cretaceous deformational episode proposed recently by Irwin.—W.C.C.

00664 **Picard, M. Dane.** Stratigraphy and depositional environments of the Red Peak Member of the Chugwater Formation (Triassic), west-central Wyoming: Wyoming Univ. Contr. Geology, v. 6, no. 1, p. 39–67, illus., tables, 1967.

Red beds of the Red Peak Member of the Chugwater Formation are divided into regional facies (ascending order, thickness in feet): silty claystone, 145–265; lower platy, 125–375; alternating, 200–425; upper platy, 20–75; and sandy, 4–30. Average depositional environments are distinguished for each facies by associations of sedimentary structures and bedding types, petrography, and geometric configuration of beds; these criteria indicate the Red Peak contains facies deposited in a paralic and nearshore marine complex bordering the Triassic miogeosyncline on the west. Moderate tectonic uplift in source areas, or emergence of new source areas, initiated a flood of poorly sorted fine-grained material onto a subsiding craton at beginning of Red Peak time. Generally quiescent conditions persisted for millions of years and there was probably little uplift in source areas or subsidence on the shelf; depositional rates were slow.—*from* Author's abstract

**Pickering, Samuel M., Jr.** *See* Englebright, Steven C. 00864

10725 **Pidgeon, R. T.; O'Neil, James R.; Silver, Leon T.** Uranium and lead isotopic stability in a metamict zircon under experimental hydrothermal conditions: Science, v. 154, no. 3756, p. 1538–1540, illus., table, 1966.

Disturbance of the uranium-lead isotopic system in a metamict Ceylon zircon has been produced in a 2 molal NaCl solution at 500°C and 1,000 bars fluid pressure. Loss of radiogenic lead to the extent of 61 percent in 13 days was the most significant effect. The experimental results support the episodic rather than continuous lead-loss interpretation of natural zircon systems utilized in geochronology.—Authors' abstract

00717 **Pilkey, Orrin H.; Luternaurer, John L.** North Carolina's Frying Pan phosphates: Geo-Marine Technology, v. 3, no. 1, p. 24–25, illus., 1966–1967.

An area of phosphate-rich sand was discovered off Cape Fear, N. C., by the Duke University Geology Department and Marine Laboratory. The deposit occurs in an elongate area 3 to 4 miles wide and 10 miles long in water depths between 20 and 30 meters and appears to have been derived by weathering from an underlying limestone. If this idea of origin is correct the thickness will depend on sub-bottom topography and length of time the limestone has weathered. The richest sample

contained 8 percent $P_2O_5$ and 40 percent phosphate grains by count. Further investigation in the area is warranted.—B.S.H.

10837 **Pincus, H. J.** Capabilities of photoelastic coatings for the study of strain in rocks, *in* Testing techniques for rock mechanics—ASTM, 5th Pacific Area Natl. Mtg., Seattle, 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 402, p. 87–102, illus; reply to discussion by B. W. Paulding, Jr. and D. F. Coates, p. 103–105, 1966.

Rock strain can be studied utilizing continuously and peripherally cemented photoelastic sheets and frozen-stress ring photoelastic gages in integrating mounts. Standard errors of estimate of strain differences and of principal strains are given. Strain levels as low as several tens of $\mu$in./in. can be measured with confidence. Results are consistent among continuously bonded and integrating mounts, rectangular and circular sheets, different loading schemes, and different lighting and viewing arrangements. Frozen ring photoelastic gages are easily read and indicate directions of principal strains. Work with rock specimens and aluminum bars gives similar results. Photoelastic coatings are very sensitive indicators of fractures and other types of anisotropy.—M.S.T.

10831 **Pincus, Howard J.** Optical processing of vectorial rock fabric data [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 173–177, illus., 1966.

Vectorial rock fabric data, from the scale of photomicrographs to that of aerial photographs, can be analyzed by an optical data-processing method already applied to seismic data. Each photograph is reduced to a transparency that acts as a diffraction grating through which laser light is passed. The frequency distributions of direction and spacing can be taken directly from the resulting two-dimensional Fourier transform. Directional and spatial filtering of the original image can be accomplished by blocking out parts of the transform.—Author's abstract

00844 **Pitts, A. E.; Ryan, D. E.** Fluorimetric determination of lithium with dibenzothiazolylmethane [with French and German abs.]: Anal. Chim. Acta, v. 37, no. 4, p. 460–464, illus., 1967.

Lithium is determined by measuring the fluorescence produced on reaction with dibenzothiazolylmethane, which has been used successfully in the detection and determination of zinc, the only other metal that fluoresces. The practical limits for the determination of lithium in salts are from 0.5 to 20 $\mu$g although 0.01 $\mu$g can be determined in pure solutions. The Fletcher volatilization procedure or the Kallman method provides a means of isolating the alkali chlorides from mineral material containing lithium for the fluorometric determination of trace amounts.—G.D.C.

00932 **Plebuch, Raymond O.; Hines, Marion S.** Water resources of Pulaski and Saline Counties, Arkansas: U.S. Geol. Survey Water-Supply Paper 1839-B, p. B1–B25, illus., tables, 1967.

Pulaski and Saline Counties, an area of 1,506 sq mi in central Arkansas, consists of the Interior Highlands in the west and the Coastal Plain in the east. In the Interior Highlands, surface water offers greater possibilities than ground water for water supplies, whereas in the Coastal Plain it is easier to develop ground water in relatively large quantities. Two aquifers, units 3 [Tertiary] and 9 [Quaternary], yield as much as 350 and 2,000 gpm of water, respectively. A third aquifer, unit 7 [Tertiary], is as yet relatively undeveloped in the project area, but yields 860 gpm to a well south of the project area. These aquifers yield water that, with treatment, is suitable for most uses.—*from* Authors' abstract

10734 **Poland, J. F.; Evenson, R. E.** Hydrogeology and land subsidence, Great Central Valley, California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 239–247, illus., tables, 1966.

This paper describes the significant geomorphic features of the Great Central Valley, presents a tentative correlation of the geologic units that constitute significant

elements of the tremendous ground-water reservoir, summarizes the post-Miocene geologic history, and describes briefly the ground-water conditions of the valley. The extent and magnitude of the land subsidence that is taking place in the San Joaquin Valley is also described, and the resulting decline in artesian head, as a result of intensive pumping of ground water.—Authors' introduction

**Pollack, S. S.** *See* Granquist, W. T. 00725

**Poncelet, E. F.** *See* Barry, A. J. 10899

00874 **Press, Frank.** Geophysics in man's expanding domain: Geophysics, v. 32, no. 1, p. 8–11, 1967.

This keynote address at the 1966 annual international meeting of the Society of Exploration Geophysicists makes some predictions concerning the future role of geophysics in human progress. The search for oil and minerals will accelerate; mining geophysics will undergo the same sort of revolution in technique and interpretation as did oil exploration in the past decade; the distinction between applied and basic geophysics will become fuzzy; the sea floor will hold comprehensive geophysical observatories; rock mechanics will come to the forefront in the next decade; in seismology, the main effort will be in the field of earthquake prediction; and results with profound effects on man and science will emerge in the field of space and planetary physics.—D.B.V.

10691 **Press, Frank.** Free oscillations, aftershocks, and Q, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 498–501, illus., 1966.

The question whether free oscillations are prolonged by aftershocks, leading to systematic overestimates of Q, is explored. The aftershock sequences for the Chilean earthquake of 1960 and the Alaskan earthquake of 1964 were used in a program that estimates energy decay for the entire sequence of main shocks and aftershocks. If it is assumed that the relative excitation of free oscillations is determined by the relative energy in the aftershock, then systematic errors occur in a Q range and for modes that are significant in recent estimates of Q in the mantle. It is pointed out that the bottom of the low-Q zone of the upper mantle is much deeper than 400 km under this assumption and may be as deep as 700 km.—Author's abstract

**Price, R. A.** *See* Norris, D. K. 10903

**Pryslak, A. P.** *See* Davies, J. C. 00939

**Pryslak, A. P.** *See* Davies, J. C. 00940

00663 **Pundareekakshudu, K.** Quartz-feldspar separation by flotation method: Wyoming Univ. Contr. Geology, v. 6, no. 1, p. 69–70, illus., 1967.

Quartz can be separated from feldspars, particularly from oligoclase and andesine, by using an inexpensive flotation method. The apparatus and chemicals needed for this method are described. The method is simple, rapid, non-hazardous, and less expensive than specific gravity methods and might also be useful for segregating microfossils.—Author's abstract

00686 **Putnam, William L.** Joel Ellis Fisher—1891–1966: Jour. Glaciology, v. 6, no. 46, p. 579, portrait, 1967.

00660 **Pytkowicz, Ricardo M.** Carbonate cycle and the buffer mechanism of recent oceans: Geochim. et Cosmochim. Acta, v. 31, no. 1, p. 63–73, illus., table, 1967.

A working model is derived to represent the carbonate cycle and part of the carbon dioxide cycle in the recent oceans, which incorporates previously unreported rates of calcium carbonate solution and carbon dioxide regeneration at depth and interchanges of carbon dioxide between the two cycles. A range of values for the rate of removal of calcium carbonate from the oceans is calculated. The role of

silicates in buffering the oceans is examined and found to be negligible for problems involving time scales not exceeding 1,000 years, but important for longer times.—D.B.V.

00714 **Quillian, R. G.** Reef suite forms one gas reservoir: Canadian Petroleum, v. 8, no. 1, p. 17–20, illus., 1967.

The Tilbury gas field, part of the single largest gas reservoir in Ontario, is confined within a carbonate–evaporite sequence in which four dominant microfacies are recognized—coral reef detrital, ostracodal, flat stromatolite supported dolomite and evaporite. A fifth facies is inferred—an intact coral bioherm. Brief petrologic descriptions of each facies are given and the depositional environment discussed.—B.S.H.

00792 **Radtke, Arthur S.; Taylor, Charles M.; Hewett, D. F.** Aurorite, argentian todorokite, and hydrous silver-bearing lead manganese oxide: Econ. Geology, v. 62, no. 2, p. 186–206, illus., tables, 1967.

Silver-rich manganese oxides from the Aurora mine, Hamilton district, Nevada, were analyzed by electron microprobe and X-ray diffraction, and examined in polished section. Aurorite (new mineral name) is argentian chalcophanite with 44 percent Mn, 7.5 percent Ag, and only 0.25 percent Zn. X-ray diffraction indicates cell size slightly smaller than chalcophanite. Argentian todorokite has 43.5 percent Mn and 3.9 percent Ag. A hydrous silver-bearing lead manganese oxide rimming argentian todorokite has 40 percent Mn, 1.18 percent Ag, and 15 percent Pb. "Associated minerals include cryptomelane, pyrolusite, birnessite(?), cerargyrite, native silver, quartz, and manganoan calcite."—W.S.W.

00706 **Ragland, Paul C.; Billings, Gale K.; Adams, John A. S.** Chemical fractionation and its relationship to the distribution of thorium and uranium in a zoned granite batholith: Geochim. et Cosmochim. Acta, v. 31, no. 1, p. 17–33, illus., tables, 1967.

Major element and radiometric analyses were made on 79 samples from the Enchanted Rock batholith in the Llano Uplift of Texas. The major-element data confirm the fact that the batholith is more complexly zoned than in the classic manner. Evidence is offered that the magma fractionated before and/or during emplacement rather than after. Anomalously high thorium and uranium values can be correlated with the presence of allanite and abundant sphene; a decrease in uranium with increasing fractionation may be due to increasingly effective oxidative processes during magmatic crystallization. Thus, the distribution of thorium and uranium within the batholith is controlled by secondary processes.—D.B.V.

10715 **Rainwater, E. H.** Miocene of the Gulf Coastal Plain of the United States of America, *in* West African Micropaleontological Colloquium, 2d, Ibadan [Nigeria] 1965, Proc.: Leiden, Netherlands, E. J. Brill, p. 141–161, illus., table, 1966.

Miocene strata are exposed in an almost continuous belt across the coastal plain; thickness in the central section is at least 20,000 feet, in the western region more than 10,000 feet, but in the eastern Gulf Coast less than 500 feet. Because of oil and gas production in coastal and offshore Louisiana and Texas, several thousand wells have penetrated the Miocene, and Foraminifera studied from many of them, so that much is known about the depositional history, particularly the shifting deltaic sites of the ancestral Mississippi River in the central Gulf Coast. The summary given here points out the importance of Foraminifera in establishing age, and regional and local correlations; the close relationship between oil and gas occurrence and depositional environment of reservoir beds; and compares it with the Miocene of Nigeria.—G.D.C.

00767 **Ratté, James C.; Steven, Thomas A.** Ash flows and related volcanic rocks associated with the Creede caldera, San Juan Mountains, Colorado: U.S. Geol. Survey Prof. Paper 524-H, p. H1–H58, illus., tables, 1967.

The Creede caldera volcanic sequence of ash and lava flows probably represents a genetic sequence derived from a common source magma that was erupted from

vents within or bordering the Creede caldera. Early eruptions were dominated by ash flows, and later eruptions by lava flows. The rocks show a general change with time from crystal-poor rhyolite to crystal-rich quartz latite. The ash-flow formations range from several hundred feet to more than 6,000 feet in thickness, and are further characterized by the great thicknesses and extreme welding of many individual cooling units. Ash-flow boundaries within densely welded tuff have been identified by detailed studies of density variations and changes in the abundance and size-sorting of phenocrysts.—J.C.R.

00901 **Reilly, P. T.** The pirated spring at Stanton Cave [Grand Canyon]: Caves and Karst, v. 9, no. 1, p. 5, 1967.

Observation of a spring emerging in the Colorado River bed below Stanton Cave in Marble Gorge, Arizona, lends strong support to the theory that karst waters flow beneath the Colorado River via solution channels and enlarging caves.—B.S.H.

**Rich, E. I.** *See* Emerson, D. O. 10746

**Riedel, William R.** *See* Friend, Jennifer K. 00856

**Riegler, R. L.** *See* Peake, W. H. 10882

00647 **Rigby, J. Keith; McIntire, William G.** The Isla de Lobos and associated reefs, Veracruz, Mexico: Brigham Young Univ. Geology Studies, v. 13, p. 3-46, illus., 1966 [1967].

The reef which surrounds Isla de Lobos is the northernmost reef with a sand cay on the western margin of the Gulf of Mexico. In leeward development broad, flat-bottomed, but steep-walled grooves, are in contrast to more narrow V-shaped grooves in windward development. The reef toe is flanked by calcareous, reef-derived sand on all but the northeast side, where scattered data suggest a rocky floor. Lagoonal, reef, and deep-water habitats and communities seem closely related to substrate character.—G.D.C.

00925 **Riley, R. A.** Meath township, District of Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 403, scale 1 in. to 1/4 mi., text, 1967.

The text for Meath township is abstracted with the citation for Glasgow township (see Riley, Map 402).—M.C.M.

00926 **Riley, R. A.** Rennie township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 404, scale 1 in. to 1/4 mi., text, 1967.

The text for Rennie township is abstracted with the citation for Glasgow township (see Riley, Map 402).—M.C.M.

00937 **Riley, R. A.** Glasgow township, District of Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 402, scale 1 in. to 1/4 mi., text, 1967.

Geological mapping in Glasgow, Meath, and Rennie townships is difficult due to a lack of outcrop, reflecting heavy forest cover and an extensive mantle of Pleistocene deposits. Intercalated with mafic volcanics are porphyritic dacite, porphyritic dacite breccias, and massive dacite. Metasediments are of volcanic origin. Other map units are iron formation, intermediate to felsic metavolcanics, mafic intrusive rocks, metasediments, granitic rocks, serpentinized peridotites, diabase dikes, and quartz and hornblende diorite. The main structural feature is the northwest- to west-trending metasedimentary-metavolcanic belt. Although the townships have been prospected intensively, no resources of economic importane have been located. M.C.M.

00900 **Rimsaite, J. H. Y.** Studies of rock-forming micas—Physical properties, chemical compositions, and paragenesis [with French, German, Russian abs.]: Canada Geol. Survey Bull. 149, 82 p., illus., tables, 1967.

Mineralogical and petrological studies of 50 mica concentrates, prepared for K–Ar dating, and of their host rocks were carried out in order to establish the relation between the chemical composition of fresh micas and the following physical properties: optical and X-ray diffraction properties, specific gravity and specific magnetic susceptibility, and stability on heating. This relationship is illustrated in 15 working curves. The chemical composition of mica is related to the type of host rock, sequence of crystallization, and associated minerals. A special emphasis is placed on rocks containing more than one generation of micas. A final chapter gives notes on the interpretation of isotopic ages.—G.D.C.

10682 **Ringwood, A. E.; Green, D. H.** Petrological nature of the stable continental crust, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 611–619, illus., tables, 1966.

A model of the continental crust with a granitic upper layer passing downward into a gabbroic layer is examined in light of recent experimental and petrologic evidence. Under P–T conditions in the lower crust, rocks of gabbroic composition would crystallize as eclogites under dry conditions, and amphibolites under wet, so the gabbroic lower crust concept should be abandoned. In dry conditions of stable continental areas having a complex evolution the lower crust is probably in the eclogite facies, but in areas of simple evolution under wet conditions, might contain large amounts of amphibolite. The Lake Superior region belongs to the latter, possibly evolving from thick submarine basaltic lavas which underwent no strong deformation or heating above 600°C. Thus the upper crust might be composed of rocks of greenschist facies and the lower of amphibolites; this model matches the geophysical properties of the crust.—E.S.L.

10881 **Rinker, J. N.; Evans, S.; Robin, G. de Q.** Radio ice-sounding techniques, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 793–800, illus., 1966.

During the summer of 1964 a cooperative research project team traversed some 450 miles of the Greenland Ice Cap to evaluate two VHF band radar systems for measuring ice thickness and contouring the bedrock profile at the ice/rock interface. A continuous radar trace of the bedrock was obtained for some 450 miles of traverse and through ice thicknesses of 4,600 feet.—Authors' abstract

00692 **Ritter, Dale F.** Terrace development along the front of the Beartooth Mountains, southern Montana: Geol. Soc. America Bull., v. 78, no. 4, p. 467–483, illus., tables, geol. map, 1967.

Each east-flowing major stream in the Beartooth Mountains formed five distinct well-developed terrace levels during the Pleistocene Epoch. Valley aggradation was a result of stream piracy of major rivers by tributary streams heading in the plains and much of the terrace-capping gravels were deposited as outwash during episodes of mountain glaciation.—A.G.

00716 **Rivette, J. F.** How advanced are your hunting skills?: Canadian Petroleum, v. 8, no. 1, p. 15–16, illus., 1967.

Computer and non-computer techniques in petroleum exploration are compared and the advantages of a computer-oriented program are stressed.—B.S.H.

00911 **Robertson, James A.** Recent geological investigations in the Elliot Lake–Blind River uranium area, Ontario: Ontario Dept. Mines Misc. Paper MP 9, 31 p., illus., 1967.

The Archean rocks of the Elliot Lake–Blind River area are 2,500 m.y. old granitic rocks of gneissic granodiorites and massive, slightly radioactive quartz monzonite. The lower Huronian consists of the Lower, Middle, and Upper Mississagi Formation, the Bruce Conglomerate, the Espanola Formation, and the Serpent Formation. These units contain a variety of sediments whose thicknesses and facies changes show a northwesterly source and northerly overlap. There were at least three phases of post-Huronian igneous activity: 1) Nipissing diabase dikes and sills;

2) Cutler granite; and 3) olivine diabase dikes. Copper mineralization is associated with the Nipissing diabase. Uranium ores in quartz-pebble conglomerates near the base of the Lower Mississagi Formation are considered to be placer deposits. Author's abstract

**Robin, G. de Q.** *See* Rinker, J. N. 10881

00657 **Robinson, E.** Submarine slides in White Limestone Group, Jamaica: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 4, p. 569–578, illus., table, 1967.

In the Eocene White Limestone Group at Lloyds, southeastern Jamaica, submarine sliding has brought layers of coarse clastic carbonate and non-carbonate material into a sequence of planktonic foraminiferal micrite. It is concluded that there were no nearby land areas at the time the sediments were deposited and that the exotic material was derived from penecontemporaneously formed shallow-water carbonates and from older non-carbonate rocks cropping out on a submarine bank or the edge of a submarine fault scarp.—Author's abstract

**Robinson, Rhoda.** *See* Pakiser, L. C. 10683

**Rodda, Peter U.** *See* Fisher, W. L. 00836

**Rodriquez, Joaquin.** *See* Gutschick, R. C. 00677

00830 **Rogers, William B.; Hays, William H.** Geologic map of the Fredonia quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-607, scale 1:24,000, sections, text, 1967.

The Fredonia quadrangle includes part of the southern edge of the western Kentucky fluorspar mining district. Between the late 1890's and the 1950's mines along the Tabb Fault system produced several hundred thousand tons of crude ore; fluorite only was recovered by the milling processes used. None of the mines is now active. Fault zones contain most of the ore deposits; large deposits have been found where wall rock consists of the St. Louis and Ste. Genevieve Limestones or lower Chester limestone units. Two limestone units in the Fredonia Valley quarry are 30–36 feet thick and average over 97 percent calcium carbonate.—M.C.M.

10695 **Roller, J. C.; Jackson, W. H.** Seismic-wave propagation in the upper mantle—Lake Superior, Wisconsin, to Denver, Colorado, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 270–275, illus., tables, 1966.

Seismic waves generated by 10 chemical explosions in Lake Superior were recorded by the U.S. Geological Survey at intervals of approximately 30 km along a line 1,400 km in length, from Lake Superior, Wis. to Denver, Colo. The data indicate a two-layer crust 50 km thick. The 8.5 kmps apparent velocity observed as first arrivals appears to be a refracted wave from a layer in the upper mantle at a depth of 105 km. The attenuation of P-waves propagating in the upper mantle is extremely low in the Central Lowlands and the Great Plains. The data do not indicate the existence of a 'shadow zone' attributed to a Gutenberg low-velocity layer for P-waves in the upper mantle.—*from* Authors' abstract

10817 **Roots, E. F.** The northern margin of North America—A progress report on investigations and problems, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 188–190, 1966.

Knowledge of the nature of the northern margin of the North American continent and its structural relationship to the crust beneath the Arctic Ocean is still largely speculative. Accumulating geological and geophysical evidence indicates that some of the traditional ideas may need revision. Two general themes are highlighted: (1) the crust beneath the Arctic Ocean is complex and with behavior neither typically oceanic nor continental, but with some features indicative of both, and thus with a complicated and obscure transition to the continental crustal block; and (2) the

northern edge of the North American block itself is a region of greater recent and current tectonic and crustal activity than has hitherto been realized. Some of the more significant discoveries are summarized briefly.—B.S.H.

**Rosholt, J. N.** *See* Somayajulu, B. L. K. 10795

**Roth, Edward F.** *See* Wallace, Robert E. 00629

00801 **Row, Ronald V.** Acoustic-gravity waves in the upper atmosphere due to a nuclear detonation and an earthquake: Jour. Geophys. Research, v. 72, no. 5, p. 1599–1610, illus., table, 1967.

A traveling ionospheric disturbance similar to that associated with Novaya Zemlya nuclear detonation, but much weaker, was noted after the Great Alaskan earthquake of March 1964. Both disturbances exhibit an abrupt onset and an oscillatory long-period tail, properties characteristic of the propagation of a disturbance from a localized impulse source in an unbounded dissipationless, planar, nonrotating, gravitationally stratified isothermal neutral atmosphere. The theory for pulse propagation in such an atmosphere is developed, including a simple closed-form approximation appropriate to long-period components of the motion.—D.B.V.

00842 **Rowe, J. J.; Morey, G. W.; Silber, C. C.** The ternary system $K_2SO_4$–$MgSO_4$–$CaSO_4$: Jour. Inorganic and Nuclear Chemistry, v. 29, no. 4, p. 925–942, illus., tables, 1967.

In the study of melting and subsolidus relations in this system, the problem of decomposition in the binary $MgSO_4$–$CaSO_4$ system at high temperatures was partly overcome by a novel sealed-tube quenching method, by hydrothermal synthesis, and by long-time heating in the solidus. Results show: a new compound, $CaSO_4 \cdot 3MgSO_4$ with a field extending into the ternary system; a high-temperature $MgSO_4$; inversion of anhydrite to $\alpha CaSO_4$ at 1195°C; melting point of $MgSO_4$ at 1136°C and of $CaSO_4$ at 1492°C; calcium langbeinite as the only compound in the binary system; a continuous solid solution series between congruently melting langbeinite and incongruently melting calcium langbeinite; and extension of the $CaSO_4$ field over a large portion of the system.—G.D.C.

**Rowe, J. J.** *See* Fournier, R. O. 10870

**Rowntree, T. C.** *See* Howe, A. C. A. 00813

10755 **Rusnak, Gene A.** The continental margin of northern and central California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 325–335, illus., tables, 1966.

The geology of the continental margin offshore, though actively studied in recent years, is still very incompletely known. Much of the data is in the remote sensing category. The author discusses some possible conclusions about geologic structures of the area based on current gravity studies and seismic investigations. Much more information is needed to ascertain the relation between continental crustal and oceanic crustal movements.—M.S.T.

**Russell, R. D.** *See* Ostic, R. G. 00888

00656 **Rutledge, J. Raymond.** A study of fluid migration in porous media by stereoscopic radiographic techniques: Brigham Young Univ. Geology Studies, v. 13, p. 89–104, illus., 1966 [1967].

Stereoscopic radiography of small-scale fluid migration permits visual observation in three dimensions of the fluid front and its relation to sedimentary structures in samples limited to about 3 cm thickness. Thirty percent of all homogeneous sandstones used in this study developed anisotropic flow patterns resulting from cryptostructures. This represented controlled flow patterns in 80 percent of the homogeneous samples in which cryptostructures had been detected by radiography. Little or no control was effected by cryptostructures in 22 percent of all the sandstone samples including both visibly stratified and homogeneous types. It is concluded

that cryptostructures affect fluid movement only to the extent that they represent aggregate differences in effective porosity.—G.D.C.

10912 **Rutter, N. W.** Multiple glaciation in the Banff area, Alberta: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 620–626, 1966.

Evidence of late Wisconsin glaciation consists of till, moraines, and outwash deposits that reveal three advances of ice down the valleys from the Continental Divide. These advances, described as Bow Valley advance, Bow Valley re-advance, and Eisenhower Junction advance, are correlated with the three stades of the Pinedale Glaciation.—W.A.C.

**Ryan, D. E.** *See* Pitts, A. E. 00844

10902 **Rydstrom, Hubert O.** Interpreting local geology from radar imagery, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 193–201, illus., 1966.

The intensity of radar return energy, as modified by the factors of radar illumination, surface roughness, and the geometry of objects, is discussed as applicable to local geologic interpretation. The principles involved are described and applied to analyses of local geology in the southwestern United States. Consideration is given to the use of return intensity in conjunction with geomorphic features to obtain a maximum of information. Local geologic interpretations of radar imagery are applicable to military terrain intelligence, natural resources exploration, and planetary exploration.—Author's abstract

10679 **Sacks, I. S.** A broad-band large dynamic range seismograph, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 543–553, illus., 1966.

Some causes of serious distortion in long-period seismographs operating in earthquake regions are briefly indicated. A low-distortion magnetic tape recording seismograph covering the frequency range of 1/30 to 30 cps at ground amplitudes of 5 mm down to ground noise is described. The power drain of the system is about 15 watts, and one 10 1/2 inch-diameter reel of 1-inch magnetic tape records for three months.—Author's abstract

**Saenz, R.** *See* Murata, K. J. 10861

10824 **Sage, Joseph D.** Deformational response of rock at low stress levels [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 489–493, illus., table, 1966.

The article contains a brief discussion of the deformational response of rock at low stress levels in terms of structural discontinuities represented by grain boundaries, grain boundary microfractures and grain orientation. A theoretical relationship and corresponding model is developed, in terms of plastic deformation on the domain of the grain in conjunction with a stress transfer to adjacent grains, to account for observed non-linear, time-dependent, strain response to stress in polycrystals.—Author's summary

00904 **Saint-Onge, D. A.** Surficial geology, Iosegun Lake (east half), west of fifth meridian, Alberta: Canada Geol. Survey Prelim. Ser. Map 15-1966, scale 1:253,440, text, 1967.

The physiographic units of the Iosegun Lake area have been carved out of flat-lying Cretaceous sandstone and shale. Bedrock is covered by 10–25 feet of unconsolidated overburden. Glaciofluvial deposits range from cobbly to loamy sand; glaciolacustrine deposits are rhythmically bedded clay, clay loam, and silty-clay loam. Recent river deposits tend to be fine textured in small valleys and coarse along the Athabasca River. During the climax of the last glaciation the continental ice sheet spread across the area and formed numerous and sometimes extensive glacial lakes between the ice and higher land to the south. Beaches and wave-

cut benches are poorly developed and difficult to identify. Glacial Lake Rycroft lasted until the Lesser Slave Lake area became ice free.—M.C.M.

00671 **Samara, George A.** Insulator-to-metal transition at high pressure: Jour. Geophys. Research, v. 72, no. 2, p. 671–678, illus., table, 1967.

Experimental results concerning the transition to the metallic state in a number of insulators and semiconductors under high pressure are reviewed and discussed. This transition occurs by two mechanisms. In the first, the metallic state is reached as a result of a continuous decrease and eventual disappearance of the energy gap; this case is exemplified by the pressure behavior of thallous iodide and iodine. In the second, the metallic state appears discontinuously as a result of a first-order phase transformation to a more closly packed lattice. The transitions in Si, Ge, and some group III–V and II–VI compounds offer good examples. These results may have a bearing on the nature of the mantle-core boundary and the electrical conductivity of the mantle.—D.B.V.

00678 **Sando, W. J.** Madison Limestone (Mississippian), Wind River, Washakie, and Owl Creek Mountains, Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 4, p. 529–557, illus., 1967.

Southeastward thinning of the Madison Limestone is mainly the result of a progressive decrease in sedimentation rate and partly the result of pre-Amsden erosion. Two units in the upper half, interpreted as solution zones, are correlated with similar zones in the Mission Canyon Limestone in Montana and western Wyoming. Two faunal zones are of great value for correlation. A revised interpretation of the age, correlation, and significance of the Sacajawea Member of the Madison is given. The lowermost part of the Madison may be the same age as a part of the Lodgepole Limestone of Montana.—W.L.A.

**Sangster, D. F.** *See* Hood, P. J. 00780

00805 **Sassa, K.; Coates, D. F.; Ito, I.** Coupling and stress waves in close proximity to surface explosions: Internat. Jour. Rock Mechanics and Mining Sci., v. 4, no. 2, p. 229–243, illus., tables, 1967.

Detonation pressures of explosives and peak stress in shock waves generated by detonation of two different explosives in magnetite rock were measured by means of modified aquarium and pin-contact techniques. Results obtained are: (1) The modified aquarium technique is satisfactory for obtaining the detonation pressure of an explosive; (2) attenuation of peak stress in shock waves generated by a surface explosion in magnetite follows an exponential law over a limited range of stress; (3) a change in variation of compressibility with stress in the magnetite occurs at a stress of about 150 kb; (4) the acoustic, or elastic, theory of coupling is roughly applicable to shock transmission from explosives to rock; (5) when imposed pressure exceeds 150 kb, a type of plastic wave seems to be generated in the rock.—*from* Authors' abstract

00869 **Sato, R.; Espinosa, A. F.** Dissipation factor of the torsional mode of ${}_0T_2$ for a homogeneous-mantle Earth with a soft-solid or a viscous-liquid core: Jour. Geophys. Research, v. 72, no. 6, p. 1761–1767, illus., tables, 1967.

Detailed study of the fundamental free torsional oscillations of a homogeneous-mantle Earth model, assuming the core to be perfectly elastic, shows that there are over-, under-, and double-frequency areas for various core rigidities. The most easily excited frequency is that which contributes least energy, and it is closest to the solution for a perfect liquid-core model. It is difficult to determine core rigidity because the splitting width of ${}_0T_2$ does not follow a well-behaved pattern; however, the results obtained here are consistent with the upper bound of the core rigidity determined by others. Core viscosity is found to vary from 0.35 to $4.7\times10^{11}$ poises, assuming that Q varies from 200 to 400 and $Q_M = 580$.—D.B.V.

**Sato, Yasuo.** *See* Landisman, Mark. 10701

00697 **Saul, Richard B.** The Calaveras fault zone in Contra Costa County, California: California Div. Mines and Geology Mineral Inf. Service, v. 20, no. 3, p. 35–37, illus., 1967.

Detailed geologic mapping in the Walnut Creek quadrangle by the California Division of Mines and Geology has revealed data that indicate significant right-lateral slip in the Calaveras fault zone in that area. Good evidence exists for post-Pliocene movement along the western margin and much older movement near the eastern margin.—B.S.H.

10862 **Schairer, J. F.** Silicate systems bearing on the crystallization courses in alkali basalts: Bull. Volcanol., v. 29, p. 657, 1966.

When the nepheline–forsterite–silica–diopside tetrahedron is expanded to nepheline–forsterite–silica–$Ca_2SiO_4$, the courses of crystallization and composition of the liquid can be followed by studying a series of joins within this expanded tetrahedron. The ultimate goal of crystallization is found to be the quaternary invariant point diopsidic pyroxene + nepheline solid solution + sodic plagioclase + wollastonite solid solution + liquid at 950±5°C. This is a low melting point in a dry system. With perfect equilibrium between solids and liquid, all melilite disappears below 1,065±5°C.—D.B.V.

10712 **Scharbert, Heinz G.** Notes on the Julianehab granite of Eqaluit peninsula, Julianehab District, southern Greenland [with German abs.]: Tschermaks Mineralog. u. Petrog. Mitt., ser. 3, v. 11, nos. 3–4, p. 373–387, tables, 1966.

The Julianehab granite has its greatest extent between Kobbermine Bay and Igaliko Fjord. Its formation took place over a long space of time in the Precambrian. It is possible to distinguish Ketilidian (older) and Sanerutian (younger) granites. The older types are supposed to be autochthonous, whereas the younger show traces of older granites. In the Sanerutian period a strong reactivation is recognizable which even led to allochthonous intrusions.—Author's abstract

**Scharon, LeRoy.** *See* Ku, Chao-Cheng. 00674

**Schlocker, Julius.** *See* Bonilla, M. G. 10743

**Schock, J. P.** *See* Barringer, A. R. 10880

00682 **Scholl, David W.; Stuiver, Minze.** Recent submergence of southern Florida—A comparison with adjacent coasts and other eustatic data: Geol. Soc. America Bull., v. 78, no. 4, p. 437–454, illus., tables, 1967.

Submergence data gathered in southern Florida indicate that approximately 4,400 years (radiocarbon) ago sea level was about 4 m lower than today's level, and at about 3500 B.P. it stood 1.6 m below present level. The Florida submergence curve shows that sea level has risen more or less steadily to its present level during the last 4,400 years and that between 4400 and 3500 B.P. sea level rose at a rate close to 30 cm/100 years (1.0 ft/century). Between 3500 and 1700 B.P. the rate of rise diminished by a factor of five, and since 1700 B.P. the rate of rise has averaged only about 3 cm/100 years (0.1 ft/century). Because a considerable body of evidence points to the probable tectonic stability of southern Florida in Recent time, the recorded submergence is regarded as a measure of an eustatic change in sea level.—H.C.W.

00672 **Schreiber, Edward; Anderson, Orson L.** Pressure derivatives of the sound velocities of polycrystalline forsterite, with 6 percent porosity: Jour. Geophys. Research, v. 72, no. 2, p. 762–764, illus., table, 1967.

A sample of synthetic, polycrystalline forsterite that yielded some weak echoes at 20 mhz, a barely marginal condition for measuring elastic constants, was obtained, and pressure derivatives of sound velocities in that sample were determined. Even though the sample is porous the results should be of interest in connection with the physics of the Earth's interior, as they represent the only such data existing for forsterite. Results are tabulated.—D.B.V.

**Schroeder, J. B.** *See* Nester, J. F. 00722

**Schultz, C. H.** *See* Peake, W. H. 10882

10879 **Schultz, Charles H.** Educational needs in the field of remote sensing, *in* Symposium on remote sensing of environment (ONR and AFCRL), 4th, 1966, Proc.: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 713–715, 1966.

The major educational need in the field of remote sensing is to acquaint environmental scientists with techniques and potential uses of various sensors. It is suggested that this can be accomplished by publication of research in the "standard" journals of environmental sciences and promotion of traveling lecture series through existing programs or NASA. Other means might include: seminars at universities, development of summer institutes, development of a suitable textbook, and consolidation and simplification of existing information. With an increase in investigators skilled in the use of sensors, there should be a great increase in cooperative effort between engineers and natural scientists which would result in more interdisciplinary research proposals, dissertations, and joint doctoral examination committees.—B.S.H.

10877 **Seiglie, George A.; Bermúdez, Pedro J.** Notes on genus *Tosaia* Takayanagi in America and description of a new species: Caribbean Jour. Sci., v. 6, nos. 1–2, p. 65–69, illus., 1966.

The genus *Tosaia* Takayanagi is redescribed, based on Recent specimens of the type found off Venezuela. *Tosaia weaveri* species nova from the Miocene of Venezuela and Panamá is described.—Authors' abstract

10773 **Serafim, J. Laginha; Ulate, Carlos A.; Umana, Jorge E.** Geological explorations for a dam site [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 2: Lisbon, Portugal, Lab. Nac. Engenharia Civil, p. 667–674, illus., table, 1966.

The existing methods of exploration for the geology of dam sites are giving the possibility of designing dependable and economical types of concrete dams even in such cases where the rock foundation is not considered sound. A complete reconnaissance includes preliminary geological study, superficial stripping of the ground, completion of borings, galleries, trenches, etc., and geophysical and geotechnical tests. The final establishment of the geological history of the dam-site and surrounding vicinities, and of the evolution of the valley, is of great interest for the design of the unity dam-foundation. The site of Cachi Dam [Costa Rica] was investigated according to the above criteria, the designed structure being a very economical shell dam.—Authors' abstract

**Sharp, J. H.** *See* Brindley, G. W. 00707

00839 **Sharps, Joseph A.** Geologic map of the Fallsburg quadrangle, Kentucky–West Virginia, and the Prichard quadrangle in Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–584, scale 1:24,000, section, text, 1967.

Coal and oil are the only mineral deposits currently of economic importance in the map-area. Coal has been mined from the Princess Nos. 5, 6, 7, and 8, the Brush Creek, and three unnamed coal beds between the Brush Creek and Ames Limestone Members. Oil is produced from wells in the southeastern portion; production from the Berea Sandstone (Devonian or Mississippian) at a depth of 2,000 feet or less is low, but long-lasting. Gas is also present but not in commercial quantity. A bed of underclay lying just below the Princess No. 6 coal bed may be economically important in the future.—M.C.M.

00903 **Sheppard, Richard A.** Geology of the Simcoe Mountains volcanic area, Washington: Washington Div. Mines and Geology Geol. Map GM–3, scale about 1 in. to 3 mi., sections, text, 1967.

The oldest formation exposed in the Simcoe Mountains volcanic area is the Miocene–Pliocene Yakima Basalt; following its extrusion, quartzite-bearing gravels

of the Ellensburg Formation were deposited by southwestward flowing streams, and contemporaneous with this deposition, east-west anticlinal ridges developed. Although little regularity in the sequence of eruption of various rock types is apparent, olivine basalt was erupted throughout the volcanic history. Building of numerous basaltic scoria cones marked the closing phase of volcanism. There is no direct evidence to indicate that glaciers ever occupied any part of the mountains.—M.C.M.

**Sheridan, M. J.** *See* Crittenden, Max D., Jr. 00866

10678 **Shima, Etsuzo; Meyer, Robert.** Total system calibration of high-frequency seismograph systems by use of the Maxwell bridge, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 538–542, illus., 1966.

A method of field calibration by means of a modified Maxwell impedance bridge has been developed to span the frequency range from 1 to 20 cps. In this range, typical of seismograph systems for explosion seismic observation, losses caused by the hysteresis and eddy currents in the seismometer make simpler bridges unusable. This bridge modification introduces a resistance equivalent to that which in effect parallels the inductance of the seismometer's coil. In the field, transient input is applied to the seismograph, and ratios between the input and output spectral densities give the frequency characteristics of the system. Results obtained from the modified bridge compare favorably with those derived from the usual mass lift experiment, and demonstrate the bridge's validity.—Authors' abstract

**Shoemaker, D. P.** *See* Marsh, R. E. 00820

10814 **Shor, George C., Jr.** Continental margins and island arcs of western North America, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 216–221, illus., 1966.

The Aleutian Islands arc shows a structure that can be interpreted as caused by growth of a volcanic ridge atop a welt of thickened oceanic crust, trapping of sediments behind the arc, and regional isostatic compensation with downbowing of the ocean floor to the south. Off Southeast Alaska, a basement ridge, analogous to the island arc, occurs beneath the shelf break, and a filled trench with the landward-dipping sediments exists beneath the continental rise. Structure along the Middle American Trench is similar, with downbowed sediments on the seaward flank of the trench and a buried basement ridge at the shelf-edge. It is suggested that these represent successive stages of continental accretion. Many other areas must exist where the continental mass has grown in the same manner, requiring palaeogeographic theories to take into account changes in size and shape of the continents.—Author's abstract

10922 **Shoua, Ezra D.; Mase, George E.** Effects of confining pressure on polycrystalline rock behavior analysed by rheological theory—Pt. 1, Theoretical analysis [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 733–741, illus., 1966.

The influence of confining pressure upon stress distribution and deformation fields of polycrystalline rock under load has heretofore been studied theoretically through empirical relations which have serious shortcomings in describing accurately characteristic rock behavior. This inadequacy may be attributed in part to the fact that rock is a heterogeneous material whose crystals possess physical properties. In this investigation, the rock behavior is simulated by a rheological model composed of two independent systems, one representing the crystal properties and the second the properties of the grain boundaries. This unique arrangement offers a means whereby in the mathematical analysis the separate contributions of the crystals and grain boundaries are correlated to the degree of confinement.—Authors' summary

**Shoua, Ezra D.** *See* Mase, George E. 10923

00633 **Shreve, Ronald L.** Infinite topologically random channel networks: Jour. Geology, v. 75, no. 2, p. 178–186, illus., tables, 1967.

In an infinite topologically random channel network, the probability of randomly drawing a link, a subnetwork, or a basin with Strahler order $\omega$ is $1/2^{omega}$; and that of randomly drawing a stream of order $\omega$ is $3/4^{omega}$. The probability of randomly drawing a link of magnitude $\mu$ is equal to the probability of a first passage through the origin at step $2m-1$ in a symmetric random walk. This suggests a useful mathematical analogy between random walks and infinite topologically random networks. The probability distributions may be interpreted as crude geomorphological laws for bifurcation ratio, the link-number ratio, the length ratio, and the basin area ratio.—A.T.M.

**Silber, C. C.** *See* Rowe, J. J. 00842

**Silver, Leon T.** *See* Pidgeon, R. T. 10725

00853 **Silverman, Arnold J.; Harris, William L.** Stratigraphy and economic geology of the Great Falls–Lewistown coal field, central Montana: Montana Bur. Mines and Geology Bull. 56, 20 p., illus., tables, geol. map, 1967.

The lower part of the Morrison Formation consists of 45 to 200 feet of terrestrial mudstone and shale interbedded with gray sandstone and limestone. The upper Morrison consists of 5 to 50 feet of black shale intercalated with coal up to 12 feet thick. Regionally, basal Kootenai sandstone rests unconformably on upper Morrison Beds. The Great Falls–Lewistown coal field contains an estimated 750 million short tons of bituminous and subbituminous coal reserves in seams more than 14 inches thick. The nature and distribution of this coal make it amenable to future use for coal-steam-electric power generation in central Montana.—*from* Authors' abstract

00897 **Silvey, William D.** Occurrence of selected minor elements in the waters of California: U.S. Geol. Survey Water-Supply Paper 1535-L, p. L1–L25, illus., tables, 1967.

Waters studied for occurrence of 17 minor elements included water from springs, from wells 25–500 feet deep, and from streams; oil-field brine; and sea water from the ocean adjacent to the California coast. Data indicated the occurrence of minor elements was strongly influenced by the vertical position of the water relative to the Earth's surface, and occurrence and concentration are strongly affected by biota in the hydrologic environment. Where biologic activity is at a minimum, concentration and number of elements reached a maximum, and where biologic activity is at a maximum, as in sea water, concentration and number are at a minimum. Minor elements with highest frequency of occurrence were iron, nickel, vanadium, aluminum, molybdenum, copper manganese, and germanium; with low frequency were lead, titanium, zinc, cobalt, bismuth, chromium, cadmium, and gallium. Beryllium was not found in any waters studied.—*from* Author's abstract

00719 **Simmons, Kenneth A.** A primer on "serpentine plugs" in south Texas: South Texas Geol. Soc. Bull., v. 7, no. 2, p. 5–17, illus., table, 1967.

Numerous isolated "serpentine plugs" contained within Cretaceous to Eocene sedimentary beds occur in an arcuate belt which extends from Milam County southwestward into Dimmit County and parallels the Balcones fault zone. Surface exposures are poor; most data have been obtained from oil wells. The term is a misnomer in that texture, structure, and mineral composition suggest that the plugs are buried submarine volcanoes which occurred in Austin time. In 35 oil fields, production has been obtained from the plugs and 14 of these fields have also produced substantial amounts of oil from formations associated with the plugs.—B.S.H.

**Simonett, D. S.** *See* Ellermeier, A. K. 10889

00837 **Sirois, Roger; Dugas, Jean.** Metallogenic maps in Quebec—Their preparation and use: Canadian Mining and Metall. Bull., v. 60, no. 657, p. 38–43, 1967.

The Mineral Deposits Service of the Quebec Department of Natural Resources is engaged in the preparation of metallogenic maps as a contribution to the Canadian Sub-Committee of the Metallogenic Map of North America. The preliminary work is being done on large-scale maps. The main objective is to clearly represent information on ore deposits in a suggestive way. The design of the legend to meet these requirements is discussed. As these maps are still only descriptive, a further step will be the interpretation of data into metallogenic maps with less emphasis on the individual deposits and more on the metallogenic factors.—Authors' abstract

**Slaughter, M.** *See* Merkle, A. B. 00730

10771 **Slemmons, David B.** Cenozoic volcanism of the central Sierra Nevada, California, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 199–208, illus., 1966.

A review is given of Cenozoic activity of the area, utilizing results of recent studies in subdividing the volcanic stratigraphy into formations. Cenozoic volcanism can be divided into (1) an Oligocene to Miocene period of eruption and deposition of the Valley Springs rhyolite tuffs, (2) a late Miocene or early Pliocene period of andesite eruptions resulting in mudflows and volcanic sediments of the Relief Peak Formation (new), (3) an early Pliocene period of eruption of latite and quartz latite flows and tuffs of the Stanislaus Formation (new), and (4) later eruptions of Pliocene andesites of the Disaster Peak Formation (new), and late Pliocene to Quaternary andesites, basalts, and rhyolites.—M.S.T.

10910 **Slind, O. L.; Perkins, G. D.** Lower Paleozoic and Proterozoic sediments of the Rocky Mountains between Jasper, Alberta and Pine River, British Columbia: Bull. Canadian Petroleum Geology, v. 14, no. 4, p. 442–468, illus., 1966.

Over 30,000 feet of pre-Devonian sediments are exposed between Jasper, Alberta, and Pine River, British Columbia. The Proterozoic Miette Group contains the newly named Byng Formation. The Miette Group is unconformably overlain by rocks of the McNaughton, Mural, and Mahto Formations of Lower Cambrian age. Middle Cambrian is represented by the Hota-Adolphus, Tatei-Chetang, Titkana, Pika and Arctomys Formations and the Upper Cambrian by the Lynx Formation. Lower Ordovician is represented by the Chushina Formation and Monkman Quartzite and is overlain by the Middle-Lower Ordovician Skoki Formation. The Skoki Formation is unconformably overlain by the Upper Ordovician Beaverfoot Formation. The Lower Paleozoic section is regionally truncated by the basal Devonian unconformity.—J.R.G.

**Small, James B.** *See* Meade, Buford K. 10759

**Small, James B.** *See* Meade, Buford K. 10878

**Smith, G. E.** *See* Smith, W. H. 00873

00863 **Smith, James W.; Spalvins, Karl.** The Conasauga formations in Bartow County, Georgia, compared with formations near the type localities [abs.]: Georgia Acad. Sci. Bull., v. 25, no. 2, p. 89–90, 1967.

10856 **Smith, John W.; Harbaugh, John W.** Stratigraphic and geographic variation of shale-oil specific gravity from Colorado's Green River Formation: U.S. Bur. Mines Rept. Inv. 6883, 11 p., illus., tables, 1966.

Four variable trend surfaces were fitted by regression analysis to measurements of specific gravity of oil from oil shale cuttings from 15 wells, representing a 1,500-ft thick section of the Green River Formation. The trend surfaces reveal a decrease of specific gravity with increasing depth as well as variation with geographic position. The decrease with depth may be a consequence of higher temperature accompanying increasing depth of burial. The geographic variation probably reflects regional variation in the original thickness of late Cenozoic extrusive rocks once overlying the Green River Formation.—K.F.F.

**Smith, R. I.** *See* Chelini, J. M. 10783

10869 **Smith, R. L.; Bailey, R. A.** The Bandelier Tuff—A study of ash-flow eruption cycles from zoned magma chambers: Bull. Volcanol., v. 29, p. 83–103, illus., 1966.

This is a summary of the distribution, stratigraphy, and preliminary mineralogy and chemistry of the upper member of the Bandelier Tuff of the Jemez Mountains of northern New Mexico, a Pleistocene rhyolitic ash flow formation. It is tentatively concluded that (1) the upper flows were erupted systematically from a single magma chamber with demonstrable physical and chemical gradients; (2) there is a systematic increase in emplacement temperature, probably ranging from 550°C to more than 800°C and best explained by the cooling effect of mixing with air in a vertical eruption column before the ash flows formed; and (3) the bulk composition shows that the first material is most salic and the last most mafic.—D.B.V.

**Smith, Stewart W.** *See* Meade, Buford K. 10878

**Smith, T. Jefferson.** *See* Steinhart, John S. 10676

10704 **Smith, T. Jefferson; Steinhart, John S.; Aldrich, L. T.** Crustal structure under Lake Superior, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 181–197, illus., tables, 1966.

Several analytic techniques have been used to derive crustal structure from data obtained in the 1963 seismic experiment. The standard reverse-profile technique is poor for this complex structure; apparent velocity measurements provide limited information, but the extended time-term technique produced the most complete structural picture. The region has an unusual and rapidly varying crustal structure compared to the shield around it. A high-velocity crust was found beneath four to six km of Keweenawan sediments and volcanics. The upper-mantle velocity agrees with values found in adjoining areas. Depth to the M-discontinuity varies from 20 km west of the lake to 55 km in the east half, and a number of second-order structures were found in it.—*from* Authors' abstract

**Smith, T. Jefferson.** *See* Steinhart, John S. 10705

**Smith, Vertie C.** *See* Noble, Donald C. 00705

00873 **Smith, W. H.; Smith, G. E.** Description of late Pennsylvanian strata from deep diamond drill cores in the southern part of the Illinois basin: Illinois Geol. Survey Circ. 411, 27 p., illus., 1967.

The combined log of two deep diamond drill cores in the western Kentucky coal field provides a basis for Kentucky-Illinois interstate correlation of late Pennsylvanian strata. Within the interval of strata represented in the cores, there are 28 coal horizons, 21 marine limestone or shale members, and 11 nonmarine limestones. The stratigraphic interval includes the Henshaw Formation and all but the lowermost Lisman Formation of Kentucky, and the entire McLeansboro Group of Illinois. A composite graphic log shows lithologies in the cores to the scale of one inch to fifty feet. Key members are named and correlated with a nearby electric log (in pocket) of the same scale. Comprehensive logs are included for a detailed description.—G.D.C.

00728 **Snetsinger, Kenneth G.** High-alumina allophane as a weathering product of plagioclase: Am. Mineralogist, v. 52, nos. 1–2, p. 254–262, illus., tables, 1967.

Allophane with an exceptionally high content of alumina occurs in granodiorite in the northwest part of the Bass Lake quadrangle, Mariposa County, Calif. Chemical analysis of the mineral gives $SiO_2$ 15.1, $Al_2O_3$ 47.7, CaO 0.29, $Na_2O$ 0.24, $K_2O$ 0.14, $H_2O^+$ 20.8 percent, $H_2O^-$ 15.7 percent (alumina determined by difference), corresponding to the formula $SiO_2 \cdot 2Al_2O_3 \cdot 8H_2O$. The allophane is optically isotropic and is amorphous to infrared and X radiation. Occurrence as cores to plagioclase crystals suggests a secondary origin, and it is probable that development of allophane represents the first stage of weathering of the rock.—Author's abstract

10928 **Snow, David T.** Three-hole pressure test for anisotropic foundation permeability [with German and French abs.]: Felsmechanik u. Ingenieurgeologie, v. 4, no. 4, p. 298–316, illus., table, 1966.

Solutions to fluid discharge or pore-pressure distribution problems in pervious foundations need not assume isotropic permeability if anisotropy is measured in the field. To devise a pumping test arrangement that will measure anisotropy, a procedure for computing steady discharge from, or seepage to cylindrical cavities is derived. The cylinder analyzed may be arbitrarily oriented with respect to the principal permeability directions of an infinite, saturated, anisotropic rock mass. Independent water-pressure tests in three orthogonal drill holes oriented along predetermined principal axes, will theoretically measure the three principal permeabilities, since discharge depends nearly upon the geometric mean of permeabilities normal to each test hole.—*from* Author's abstract

00812 **Snyder, George.** Bedrock geologic map of the Columbia quadrangle, east-central Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-592, scale 1:24,000, section, text, 1967.

In the northeast quarter of the Columbia quadrangle the orientation of the Columbia recumbent fold system on the southwest flank of the Willimantic Gneiss dome places some limitations on the evolution of the dome, if the doming was simultaneous with the folding in the area. The period of deformation that produced the folding and doming was most likely the Devonian Acadian Orogeny. The Columbia recumbent fold system shows by its attitude relative to the dome that it was formed by classical flowage during folding and could not have formed by reverse drag of a bouyant dome forcing its way upward. [A fence diagram is included on the map sheet.]—*from* Author's notes

**Soffel, Heinrich.** *See* Ku, Chao-Cheng. 00674

00784 **Soga, Naohiro; Anderson, Orson L.** Elastic properties of tektites measured by resonant sphere technique: Jour. Geophys. Research, v. 72, no. 6, p. 1733–1739, illus., tables, 1967.

A new technique for determining elasticity and anelasticity of small spheres, called the resonant sphere technique, is very useful in measuring the elastic constants of small specimens. We have used this technique to measure the elastic properties of two kinds of tektites. The shear and longitudinal sound velocities for a moldavite were found 5.918 kmps, respectively, and those for an indochinite were 3.638 and 5.999 kmps, respectively. The annealing points of these tektites were also obtained by determining the shear sound velocities of tektite specimens quenched from various temperatures. They are 750°C for a moldavite and 710°C for an indochinite. The temperature variations of shear sound velocity and Poisson's ratio were also determined from room temperature to 130°C. These results show that the resonant sphere technique is a valuable tool for tektite research.—Authors' abstract

10795 **Somayajulu, B. L. K.; Tatsumoto, M.; Rosholt, J. N.; Knight, R. J.** Disequilibrium of the U-238 series in basalt: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 387–391, tables, 1966.

Radioisotope analyses of basalt samples from Hawaii, Japan, and Iwo Jima show that daughter nuclides of U-238 (Pb-210, Th-230, and Ra-226) are not in equilibrium with U-238. Estimates of uranium content in volcanic rocks determined from the daughters should be reevaluated. Evidence presented indicates that the magma source region or magma forming process should be considered as an open system, chemically. Enrichment of some uranium-daughter nuclides is insufficient to account for the excess Pb-206 in volcanic rocks. Mechanisms involving only fractionation of U-238 and Th-232 still must be considered the primary cause for variation of isotopic ratios of lead in basalt. Disequilibrium studies of Th-230, Ra-226, Pb-210, and Pa-231 may be tools for study of genetic relations among magmas.—V.S.N.

**Spalvins, Karl.** *See* Smith, James W. 00863

**Speakman, J. C.** *See* Kennard, O. 00669

**Sproll, Walter P.** *See* Dietz, Robert S. 10733

**Stanton, R. L.** *See* Ostic, R. G. 00888

00643 **Stauffer, Peter H.** Sedimentologic evidence on Eocene correlations, Santa Ynez Mountains, California: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 4, p. 607–611, illus., 1967.

Eocene sedimentary rocks crop out for 115 km between Point Conception and Ojai, Calif. Near San Marcos Pass, the "Coldwater" Sandstone conceals underlying Eocene rocks for 3–15 km. East of San Marcos Pass units are: the Juncal with Camino Cielo Sandstone Member, Matilija and Cozy Dell Formations, and "Coldwater" Sandstone; to the west are the "Matilija Sandstone" and Cozy Dell Formation with a conspicuous white sandstone, Sacate Formation, and "Coldwater" Sandstone. Studies of thickness, gross lithology, primary structure, texture, composition, and paleocurrent direction support a different correlation of the two sections. The Camino Cielo Sandstone Member and the Matilija Formation of the eastern section are probably equivalent, in part, to the "Matilija Sandstone" and the white sandstone in the "Cozy Dell Formation," of the western.—E.A.M.

10732 **Stearns, Harold; Chamberlain, Theodore.** Deep cores of Oahu, Hawaii and their bearing on the geologic history of the central Pacific basin [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 77, 1966.

00693 **Stehli, F. G.; McAlester, A. L.; Helsley, C. E.** Taxonomic diversity of Recent bivalves and some implications for geology: Geol. Soc. America Bull., v. 78, no. 4, p. 455–465, illus., 1967.

A compilation of worldwide taxonomic diversity data for Recent Bivalvia shows a consistent poleward decrease in numbers of species, genera, and families. Spherical harmonic surfaces fitted to the raw data of bivalve diversity accurately predict the position of the present equator and rotational poles at each of three taxonomic levels examined. These findings suggest that diversity studies of fossils at the specific, generic, or familial levels will prove useful for determining ancient equator and pole positions. In addition, residuals from the fitted surfaces show promise of indicating local areas of anomalous geographic or climatic history.—Authors' abstract

10714 **Stehli, F. G.** Some applications of foraminiferal ecology, *in* West African Micropaleontological Colloquium, 2d, Ibadan [Nigeria] 1965, Proc.: Leiden, Netherlands, E. J. Brill, p. 223–239, illus., 1966.

The use of models set up on the basis of known or suspected environmental responses in modern forms, tested on present-day distributions, then applied to geologic problems offers considerable promise. Large populations commonly available to the micropaleontologist provide an opportunity to lead in the application of quantitative techniques in paleontology. The combined use, in micropaleontology, of a quantitative approach and well chosen ecological models opens a way to advances of major geologic interest. The models here proposed all require further testing but they suggest means for determining paleobathymetry, reconstructing patterns of oceanic circulation, testing the hypothesis of polar wandering, and testing the presently accepted concept of the Earth's magnetic field as an axial dipole.—*from* Author's abstract

00731 **Steiger, Rudolf H.; Hart, Stanley R.** The microcline–orthoclase transition within a contact aureole: Am. Mineralogist, v. 52, nos. 1–2, p. 87–116, illus., 1967.

Microcline perthites from Precambrian pegmatites near Eldora, Colo., were converted to orthoclase in a vertical zone around a Tertiary intrusive stock. Outside the aureole, the microcline commonly consists of clear crystals with cross-hatched twinning, 2V of 80°±5°, and obliquity from 0.84 to 0.93. The orthoclase from near the contact is turbid, untwinned, with axial angles normal to (010) from 50° to 66°. The perthitization and composition of the feldspars remain roughly constant

across the contact aureole except within the last few feet. The nature of the microcline–orthoclase transition and its distance from the contact depend on the contact configuration. Heat flow calculations confirm (1) the transition is sharp and close to protruding corners of intrusive, but gradational and remote near re-entrant contact, (2) the microcline–orthoclase transition may occur at temperatures below 400°C.—E.Z.

**Steinhart, John S.** *See* James, David E. 10671

10676 **Steinhart, John S.; Smith, T. Jefferson.** (editors). The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.—Natl. Research Council Pub. 1467), 663 p., illus., tables, 1966.

The volume originated as an attempt to bring together results of the 1963 Lake Superior seismic experiments in a single publication. Since it was clear that the crust was far more complex than supposed, results from other geophysical and geologic studies in the area were added. The first two sections constitute these original plans. Papers in section 3 offer parallels and contrasts to the Lake Superior results. Theory, earthquakes, and instruments are discussed in section 4, and the final section offers some new directions in the study of the solid Earth. A total of 43 papers are included, 26 of which are cited separately.—E.S.L.

**Steinhart, John S.** *See* Smith, T. Jefferson. 10704

10705 **Steinhart, John S.; Smith, T. Jefferson.** Time terms and structure in western Lake Superior region, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 198–204, illus., tables, 1966.

Data from the Lake Superior seismic experiment of 1963 have been combined with observations from the University of Wisconsin 1958 Keweenaw profile to calculate time terms over a large part of the western Lake Superior region. A method for correlating Bouguer gravity anomalies and time terms is described and employed to determine the extent to which the observed gravity anomalies in this area may be accounted for by materials at depths less than those appropriate to the $P_3$ time terms. A residual map of the anomalies remaining after 'stripping' the effects attributable to time-term variation still shows considerable relief along the midcontinent gravity high.—Authors' abstract

00645 **Steininger, Roger.** Geology of the Kingsley Mining District, Elko County, Nevada: Brigham Young Univ. Geology Studies, v. 13, p. 69–88, illus., table, 1966 [1967].

In this northeastern area, a Tertiary stock of quartz monzonite has intruded limestones of the Upper Garden City Formation, producing a contact aureole of marble. The stock is cut by numerous dikes varying from leucorhyolite to quartz monzonite, but only a few dikes extend into the country rock. A dominant joint pattern, resulting from cooling of the intrusive, has controlled emplacement of both dikes and hydrothermal veins. Extrusive felsite porphyries form a large hill southeast of the district; field and microscopic evidence indicates that these are flow rocks. The Kingsley Mining District has produced small quantities of copper, lead, silver, gold, molybdenum, and marble, mainly during the late 1880's. Additional development seems doubtful, unless certain of the marbles can be marketed.—*from* Author's abstract

**Stemler, O. A.** *See* Deklotz, E. J. 10823

10793 **Stern, T. W.; Goldich, S. S.; Newell, M. F.** Effects of weathering on the U–Pb ages of zircon from the Morton Gneiss, Minnesota: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 369–371, illus., table, 1966.

Weathering has caused large losses of lead from the zircon in the residual clay derived from the Morton Gneiss of southwestern Minnesota, drastically reducing the Pb–206/U–238 and the Pb–207/U–235 ages. The Pb–207/Pb–206 age probably

has not been significantly affected. Loss of lead by leaching during weathering has not been adequately considered in explanation of discordant ages of zircon.—Authors' abstract

**Steven, Thomas A.** *See* Ratté, James C. 00767

00834 **Steven, Thomas A.** Geologic map of the Bristol Head quadrangle, Mineral and Hinsdale Counties, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-631, scale 1:62,500, section, text, 1967.

Oldest Tertiary rock units in the Bristol Head quadrangle are the rhyolite of Miners Creek, Shallow Creek Quartz Latite, and Bachelor Mountain Rhyolite which were derived from sources in the central San Juan Mts. Rock units from several sources are exposed and their geologic relations have important applications throughout the central, western, and northern parts of the San Juan volcanic field. Most faulting and differential uplift or subsidence displacing the rocks took place after deposition of the Nelson Mountain and Rat Creek Quartz Latites and during later stages of subsidence and resurgence of the San Luis Peak and Creede calderas. More intensive prospecting for potential mineral deposits seems indicated.—M.C.M.

**Stewart, G. A.** *See* Bally, A. W. 10716

**Strangway, David W.** *See* McMahon, Beverly E. 00666

10829 **Street, Norman; Fun-Den-Wang.** Surface potentials and rock strength [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 451-456, illus., 1966.

The strength of both Berea Sandstone and a soda-lime glass in a fluid environment are found to be primarily pH dependent, the lowest strength occurring at pH = 7. The glass has a stronger dependence of measured strength on pH than the rock, although under uniaxial compression the sandstone showed definite pH dependence. It is shown that the strength reduction can be interpreted in terms of a reduction of surface free energy acting via a Griffith mechanism. This reduction of surface free energy is brought about by the action of a potential which is a function only of the hydroxyl ion concentration for these systems. Zeta potential measurements on both materials did not correlate with strength as did the pH curves.—*from* Authors' abstract

**Stringfield, V. T.** *See* LeGrand, H. E. 10850

**Strong, H. M.** *See* Hanneman, R. E. 00769

**Stuiver, Minze.** *See* Scholl, David W. 00682

**Stuiver, Minze.** *See* Denton, George H. 00691

**Stumpfl, E. F.** *See* Halls, C. 00928

**Sun, Stanley.** *See* Ku, Chao-Cheng. 00674

00922 **Swingle, George D.** Mineral resources summary of the Boyds Creek quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 8 p., 1967.

This text accompanies Tennessee Div. Geology Geol. Map GM 156-NW by G. W. Swingle and others, 1967 (cited separately). Mineral resources mined in the Boyds Creek quadrangle are limestone, shale, sand, ochre, and possible lead. Extensive reserves of limestone, magnesian limestone, dolomite, and shale and clay are present but no quarries or mines were active in 1965. Sand dredged from the French Broad River is used for highways, concrete, and masonry. An ochre deposit in lower beds of the Pumpkin Valley Shale was once used as pigment in paint. Lead was mined in the Bays Mountain area in the late 1800's but no recent mineralization has been found. Potential resources are clay, iron ore, marble, and chert.—M.C.M.

00938 **Swingle, George D.; Harper, Delbert D.; Palmer, Raleigh A.; Milici, Robert C.** Geologic map of the Boyds Creek quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 156-NW, scale 1:24,000, sections, separate text, 1967.

The accompanying text, "Mineral resources summary of the Boyds Creek quadrangle, Tennessee," by G. W. Swingle (1967) is cited separately.—M.C.M.

00768 **Symons, D. T. A.** Paleomagnetic evidence on the origin of the Marquette and Steep Rock hard hematite and goethite deposits: Canadian Jour. Earth Sci., v. 4, no. 1, p. 1–20, illus., tables, 1967.

Several theories of genesis have been proposed for the hard hematite, mined at the Cliff–Shaft mine, Marquette Range, Mich., and hard goethite, at the Caland and Steep Rock mines, Steep Rock Range, Ontario. Paleomagnetic study of 67 samples from ore horizons and associated rocks demonstrates that both ore deposits have a prefolding remanence that differs in age from any of the associated rock units, and indicates laterite formation from oxidation and leaching of primary iron formation by meteoric solutions. The hard hematite ore was derived from magnetite-banded oxide facies, the hard goethite ore from pyrite facies. The laterites were subsequently buried, folded, faulted, and intruded, but the mineralogy, structure, and texture of the ores were essentially unchanged.—G.D.C.

00713 **Takken, Suzanne.** Subsurface geology of the North Gotebo area, Oklahoma: Shale Shaker, v. 17, no. 6, p. 115–123, illus., 1967.

Structurally the North Gotebo area, Washita and Kiowa Counties, Okla., lies on the edge of the Wichita Mountain complex immediately adjacent to the Anadarko basin. Natural gas occurs in a fault–stratigraphic trap in Mississippian and Pennsylvanian rocks. A major thrust fault serves as a migration barrier; stratigraphic trapping occurs where unconformities serve as up-dip barriers. Cross sections indicate that the Springer Formation (Pennsylvanian) dips down into the Anadarko basin in a series of folds. With this great down-dip from the producing area, large reserves could be expected in the Springer. Subsidiary folds in the basin might be expected to produce oil. Reserves in the eastern portion of the area are not large (1.5 billion cubic feet per well); in the western portion reserves are larger (6–10 billion cubic feet per well).—B.S.H.

10728 **Talwani, Manik.** Gravity anomaly belts in the Caribbean [summ.], *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 177, 1966.

10779 **Tan, Li-Ping.** Major pegmatite deposits of New York State: New York State Mus. and Sci. Service Bull. 408, 138 p., illus., tables, 1966.

Of the 25 pegmatites in New York studied for mineralogy, internal structure, and geothermometry, occurrences are limited to two geologic terranes: simple in the Precambrian of the Adirondacks, and complex in the Paleozoic metamorphic rocks of southeastern New York. The simple are muscovite-beryl type and are fewer in number. In the Adirondacks, pegmatites of the southern district are dominated by biotite, of the eastern district by biotite-muscovite and of the northwestern by metamorphosed diopside-phlogopite. Zoned textures from the border inward are granitoid, graphic, pegmatoid, massive. Flame photometric analyses indicate overlapping temperatures of crystallization from 700°C for simple to 550°C for complex pegmatites, a drop of 50°C per zone from border to core. A differentiation scheme for pegmatite development is suggested.—G.D.C.

**Tatsumoto, M.** *See* Somayajulu, B. L. K. 10795

00748 **Taubeneck, William H.** Reply [to comments on "An evaluation of tectonic rotation in the Pacific Northwest," by N. D. Watkins, 1967]: Jour. Geophys. Research, v. 72, no. 4, p. 1415–1421, illus., table, 1967.

Taubeneck presents additional information regarding geologic features of the Pacific Northwest in support of his argument (ibid., v. 71, no. 8, p. 2113–2120, 1966) that the Columbia Arc is a primary feature. It is shown that the concept of post-Miocene

tectonic bending should be a dead issue. Detailed arguments can be marshalled against any appreciable pre-Miocene rotation later than Jurassic. Advocates of rotation might argue for pre-Jurassic bending, but incomplete knowledge of the older rocks creates many uncertainties for all proponents. Until proved otherwise, a primary origin for the configuration of the Columbia Arc should remain the preferred hypothesis.—D.B.V.

**Taylor, Charles M.** *See* Radtke, Arthur S. 00792

**Taylor, G. C.** *See* Norford, B. S. 10915

**Taylor, P. T.** *See* Lee, W. H. K. 10808

00808 **Tennissen, Anthony C.** Clay mineralogy and ceramic properties of lower Cabaniss underclays in western Missouri: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 36, 56 p., illus., tables, 1967.

These underclays, investigated by X-ray diffraction, differential thermal, spectrographic, microscopic, and certain ceramic testing techniques, are units of four formations in the Cherokee Group of Pennsylvanian age, in Barton, Vernon, St. Clair, and Henry Counties. They are composed principally of illite, kaolinite, and mixed-layer illite-montmorillonite, chiefly with quartz and pyrite. The clays vary in composition both laterally and vertically, but at random rather than directional. The underclays, undistinguishable from one another on the basis of either their mineral or chemical composition, are suitable only for low grade ceramic ware. Only very general correlations can be established between composition and ceramic properties.—G.D.C.

**Tessman, Norman.** *See* Webb, S. David. 00703

00919 **Texas University Bur. Econ. Geology.** Geologic atlas of Texas, Lubbock sheet—Halbert Pleasant Bybee Memorial Edition: Austin, Tex., Univ. Texas Bur. Econ. Geology, scale 1:250,000, 1967.

00635 **Theobald, P. K., Jr.; Overstreet, W. C.; Thompson, C. E.** Minor elements in alluvial magnetite from the Inner Piedmont belt, North and South Carolina: U.S. Geol. Survey Prof. Paper 554-A, p. A1-A34, illus., tables, 1967.

Chemical and spectrographic analyses were made for 15 minor elements in 291 samples of detrital magnetite in the western Piedmont of North and South Carolina. Lead, copper, zinc, titanium, chromium, manganese, tin, and beryllium were detected in enough magnetite separates to allow data to be analyzed statistically for geographic and geologic relations. Manganese, titanium, chromium, zinc, and copper tend to group according to the four-coordinated bivalent, and six coordinated trivalent ionic radii in the magnetite lattice; lead, tin and beryllium appear to be incorporated in the lattice but positions are not known. The area is divisible into southern, middle, and northern zones characterized by particular associations of minor elements in magnetite, demonstrating that regional distribution of certain minor elements can be determined by analysis of detrital magnetite.—*from* Authors' abstract

**Thompson, C. E.** *See* Theobald, P. K., Jr. 00635

10848 **Thompson, John H.** (editor). Geography of New York State: Syracuse, N. Y., Syracuse Univ. Press, 543 p., illus., tables, 1966.

In this comprehensive geography of New York State, there are five parts with chapters contributed by various specialists in history, economics, agriculture, and recreation, as well as by geographers. Part 1 presents elements of the resource base, including a chapter on land forms by the late George B. Cressey and another on soils by David J. de Laubenfels; both are cited separately. A chapter on water, emphasizing surface supply and demand is not cited. In Part 3 the editor reviews the mineral resources and production in a chapter on primary economic activities, not cited separately.—G.D.C.

**Tilton, George R.** *See* Hart, Stanley R. 10674

10851 **Tilton, George R.** Isotopic composition of lead from granitic rocks of North America [with French, German, Russian abs.], *in* Interpretation géologique des mesures effectuées . . . géochronologie absolue—Colloques Internat., Nancy, 1965: Paris, Centre Natl. Recherche Sci., p. 41–54, illus., 1966; Sci. Terre, v. 10, nos. 3–4, p. 247–260, 1966.

Studies of isotopic composition of lead in feldspar from granitic rocks with ages of 450 m.y., Appalachians, 1100 m.y., Grenville, and 2700 m.y., Superior Province, show considerable variation within each group but composition of the least radiogenic lead agrees with that of associated "conformable galena" as defined by Stanton and Russell. Comparison of model age of least radiogenic lead with rock age suggests a systematic trend. Model ages are 150–200 m.y. younger than granitic rocks of Appalachian and Grenville age, but 200–300 m.y. older than Superior samples. Using lead from the 2700–m.y.–old rocks to calculate an age for the Earth with meteoritic lead as the Earth's initial lead, a value of 4730 m.y. is obtained; commonly quoted values are 4530–4580 m.y. Since Superior Province leads may be anomalous, the new value is tentative.—*from* Author's abstract

**Tupper, W. M.** *See* Gleeson, C. F. 00927

10698 **Tuve, Merle A.** Preface *to* Crustal structure in coastal Alaska, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 420–422, 1966.

The history of the original seismic survey in 1955, data from which is reexamined in this paper, is given, as well as the background of early attempts to find 'mountain roots' or granitic and basaltic layers in the crust.—E.S.L.

**Ulate, Carlos A.** *See* Serafim, J. Laginha. 10773

**Umana, Jorge E.** *See* Serafim, J. Laginha. 10773

10673 **U.S. Army Corps of Engineers.** Arkansas–Red River Basins, water quality control study, Texas, Oklahoma and Kansas (Pt. 1), V. 4, App. IV: U.S. Cong., 89th, 2d sess., Senate Doc. 110, p. IV–1—IV–19, illus., tables, 1966.

Salt plains on Salt Fork of the Arkansas River, the Cimarron River, Salt Creek of the Cimarron River, and North, South and Middle Forks of the Wichita River are located in a band extending from Stafford County, Kans., through western Oklahoma to King County, Tex., underlain by Permian, gypsiferous shale, siltstone, and fine–grained sandstone with massive beds of gypsum and anhydrite in the upper part. Solution of salty zones in the shale contribute to pollution of ground water circulating to the surface through zones slightly more permeable than the surrounding rocks. These salt deposits are divided into three zones; the youngest, in the Nippewalla group of Kansas up to Whitehorse formation in Texas, is the source for all salt springs and plains covered in this report.—G.D.C.

10669 **U.S. Dept.Health, Educ., Welfare.** Arkansas–Red River Basins water quality conservation, App. IX *in* [U.S. Army Corps of Engineers] Arkansas–Red River Basins, water quality control study, Texas, Oklahoma and Kansas (Pt. 1), V. 5: U.S. Cong., 89th, 2d sess., Senate Doc. 110, 71 p., illus., 1966.

In a basic study of water quality and sources of natural and manmade salt pollution, salt and gypsum are found to be the principal mineral pollutants of large volumes of surface waters and some ground waters in these basins; corrective measures are suggested. Natural brines, with 20,000 to 190,000 mg chloride per liter, come from large springs, small seeps, large marshes, or salt–encrusted flats. Of significant sources, five have been located in the Arkansas River basin and ten in the Red River basin, plus three and six of secondary importance. Fresh water recharge areas and brine emissions may be within ten miles. Some streams such as the Cimarron and Wichita Rivers are polluted primarily by natural brines; others, mainly in the

Canadian River systems, by manmade wastes. Total sulfate loading amounts to about 9,600 tons per day.—G.D.C.

**Usami, Tatsuo.** *See* Landisman, Mark. 10701

**Uyeda, S.** *See* Lee, W. H. K. 10808

**Valentine, James W.** *See* Veeh, H. Herbert. 00688

00749 **vandeLindt, W. J.** Movement of the Mohorovicić discontinuity under isostatic conditions: Jour. Geophys. Research, v. 72, no. 4, p. 1289–1297, illus., 1967.

Assuming that the M-discontinuity is a phase transition, its movement is calculated as a function of time. This movement is caused by sedimentation or erosion on the surface and by the mechanism to maintain isostatic equilibrium. It appears that the motion of the surface can be oscillatory. The influence of both the slope of the Clapeyron curve and latent heat is investigated and turns out to be small. The density and heat conduction properties of the sediment are found to be important. It is shown that, when pressure is applied at too fast a rate, the process becomes unstable.—*from* Author's abstract

10740 **VanGroos, A. F. Koster; Wyllie, P. J.** Liquid immiscibility in the system $Na_2O$–$Al_2O_3$–$SiO_2$–$CO_2$ at pressures to 1 kilobar: Am. Jour. Sci., v. 264, no. 3, p. 234–255, illus., tables, 1966.

A liquid miscibility occurs within the quaternary system, $Na_2O$–$Al_2O_3$–$SiO_2$–$CO_2$ between $Na_2CO_3$-rich liquids and $NaAlSi_3O_8$-rich liquids. The vapor-saturated liquidus surface does not intersect the miscibility gap at low pressures, but with increasing pressure it undergoes two discontinuous shifts toward the $CO_2$ apex of the tetrahedron, produced by carbonation reactions in the system $Na_2O$–$SiO_2$–$CO_2$. These position changes cause the vapor-saturated surface to intersect the miscibility gap. At 1 kilobar pressure on the join $NaAlSi_3O_8$–$Na_2CO_3$–$CO_2$, the two-liquid field occurs at temperatures above 870°C.

**Vedder, J. G.** *See* Brown, Robert D., Jr. 00639

00688 **Veeh, H. Herbert; Valentine, James W.** Radiometric ages of Pleistocene fossils from Cayucos, California: Geol. Soc. America Bull., v. 78, no. 4, p. 547–549, table, 1967.

Age estimates based on uranium and thorium isotopes in invertebrate skeletal material from marine terrace deposits at Cayucos, Calif., range from 130,000 to 140,000 years B.P. This age range suggests that the Cayucan (central California) invertebrate shelf province was contemporaneous with the Verdean (southern California) shelf province. Both provinces were probably chiefly Sangamonian but may have persisted into early Wisconsin time.—A.A.

**Verhoogen, John.** *See* Wells, John M. 00875

**Versaw, S. F.** *See* Johnson, A. I. 10713

**Vestine, E. H.** *See* Kahle, Anne B. 00876

00807 **Vineyard, Jerry D.; Fellows, Larry D.** Guidebook to the geology between Springfield and Branson, Missouri, emphasizing stratigraphy and cavern development: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 37, 39 p., illus., 1967.

In the roadcuts along U.S. Highway 65 between Springfield and Branson, there are excellent exposures of Ordovician and Mississippian strata, primarily limestone and dolomite that have been deeply weathered. Nearly vertical joints have influenced the underground movement of water. These same formations are observed also in Marvel, Fairy, and Old Spanish Caves. This guidebook was prepared for the Spring 1967 meeting of the Mississippi Valley-Ozark Regional Association of the National Speleological Society.—G.D.C.

00642 **Waananen, A. O.; Page, R. W.** Water-resources aspects, *in* The Parkfield Cholame, California, earthquakes of June-August 1966: U.S. Geol. Survey Prof. Paper 579, p. 53-56, illus., tables, 1967.

Seismic shocks from the Parkfield-Cholame earthquakes of June 27, 1966 as revealed by analog-type recorders caused abrupt and pronounced fluctuations in the stages of streams and reservoirs and in ground-water levels over an area extending a considerable distance from the Cholame Valley. However, preliminary evidence indicates few if any significant permanent effects on water resources. Data recorded at gaging stations and observation wells are tabulated and locations of stations are shown on a map.—V.S.N.

**Wagner, H. C.** *See* Johnson, William D., Jr. 00737

**Wahrhaftig, Clyde.** *See* Peck, Dallas L. 10747

**Wahrhaftig, Clyde.** *See* Bateman, Paul C. 10768

00845 **Walker, Bryan.** A diver-operated pneumatic core sampler: Limnology and Oceanography, v. 12, no. 1, p. 144-145, illus., 1967.

A light, portable core sampler was needed to take undisturbed sediment samples from high tarns that are inaccessible to vehicles or too shallow for the operation of a 6.1 m core sampler. It was desirable to make two corers, similarly constructed, one 2.4 m and one 4.3 m long. For convenient transportation the core sampler is in two parts, the body and the anchor chamber. A bouyancy pack, adjusted on the outer tube, enables the diver to maneuver the unit into any attitude to position for coring or towing to shore. A general description of the apparatus and its operation is given.—G.D.C.

**Wallace, Chester A.** *See* Crittenden, Max D., Jr. 00866

00629 **Wallace, Robert E.; Roth, Edward F.** Rates and patterns of progressive deformation, *in* The Parkfield-Cholame, California, earthquakes of June-August 1966: U.S. Geol. Survey Prof. Paper 579, p. 23-40, illus., table, 1967.

Measurements of rates and patterns of progressive deformation that followed the main shocks of the Parkfield-Cholame earthquake on June 27, 1966, were carried out by means of 10 quadrilaterals of survey markers installed on June 30 along the fracture zones and by photographs from air and ground to document the geometry and rates of deformation. Results indicate progressive tectonic creep for a 2-month period amounting to 2 inches the first day after the earthquake to 0.01 inch or less per day after a month. Evidence from damage caused by earlier displacements suggests a rate of 43 to 80 inches per century. This rate could account for the hundreds of miles of strike slip believed to have occurred in Tertiary time.—V.S.N.

**Wallace, Robert E.** *See* Brabb, Earl E. 10744

10826 **Walsh, J. B.; Brace, W. F.** Cracks and pores in rocks [with French and German abs.], *in* Internat. Soc. Rock Mechanics Cong., 1st, Lisbon, 1966, Proc., V. 1: Lisbon, Lab. Nac. Engenharia Civil, p. 643-646, illus., 1966.

The porosity of typical rocks may be divided into the broad categories of "pores" and "cracks". Cracks in samples of laboratory size are along cleavage in grains, or at grain boundaries; the role of cracks in rock masses may be assumed by joints and faults. Both cracks and pores affect mechanical behavior; the difference arises because cracks are closed by compressive stress, whereas pores are not. Thus, nonlinearity in stress-strain curves for rock and strong dependence of most rock properties on pressure can be attributed to cracks. The effect of cracks and pores on a number of parameters is explored in detail, and a model for rock is described and analyzed mathematically. Theoretical results are compared with experimental data from the laboratory.—*from* Authors' abstract

10929 **Walsh, J. B.; Brace, W. F.** Elasticity of rock—A review of some recent theoretical studies [with German and French abs.]: Felsmechanik u. Ingenieurgeologie, v. 4, no. 4, p. 283–297, illus., table, 1966.

Most rocks are not elastic in the classic sense; for example, stress–strain curves show non-linearity, hysteresis, and apparent permanent strain. The behavior of an idealized model which is a good approximation to most natural rock is analyzed. Expressions for elastic constants are derived by considering the effects of pores (more or less equant cavities) and cracks (sharp narrow cavities). Application to natural, jointed rock is discussed. [A list of 32 references is included.]—Authors' abstract

00676 **Walthall, Bennie H.** Stratigraphy and structure, part of Athens Plateau, southern Ouachitas, Arkansas: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 4, p. 504–528, illus., table, 1967.

Most of the named stratigraphic units of the frontal and central Ouachitas of Oklahoma are present in the Athens Plateau. The Jackfork Group (Mississippian) coarsens and thickens toward the south and southeast. Fossils indicate the Johns Valley Shale and basal sandstones of the Atoka Formation are early Morrow in age. The late Paleozoic flysch sequence of the Ouachitas and the Athens Plateau was deposited in a narrow east-trending geosyncline. The mapped area is a belt of ruptured east-trending folds. Reverse faults dip steeply southward.—W.L.A.

**Wampler, J. M.** *See* Weaver, Charles E. 00685

00632 **Wangersky, Peter J.; Joensuu, Oiva I.** The fractionation of carbonate deep-sea cores: Jour. Geology, v. 75, no. 2, p. 148–177, illus., tables, 1967.

Five carbonate cores [three from the Caribbean Sea and two from the Atlantic Ocean] were fractionated into three phases by physical and chemical separations. Distributions of major elements were determined in each of the phases. The composition of the residue phase, predominantly clay-sized minerals, was remarkably constant. In the carbonate phase, manganese showed signs of post-depositional rearrangement. There was no correlation between oxygen-isotope paleotemperatures and either total carbonate content or soluble strontium content.—*from* Authors' abstract

10722 **Wanless, Harold R.; Cannon, Julie R.** Late Paleozoic glaciation: Earth-Sci. Rev., v. 1, no. 4, p. 247–286, illus., tables, 1966.

A review of evidence on a worldwide basis for late Paleozoic glaciation leads to the conclusion that some localities for which evidence has been described should be interpreted otherwise. These include Squantum, Mass., Las Delicias, Mexico, and possibly some areas in South America and Australia. Detailed studies in Australia suggest as many as 51 glacial episodes with principal activity in late Carboniferous. Sea-level fluctuations resulting from growth and waning of glaciers may have caused the late Paleozoic cyclic sedimentation in the northern hemisphere. Evidence suggests that glaciated areas were at higher latitudes than at present and continents now widely separated were closer together.—V.S.N.

00886 **Warkentin, B. P.** Carbonate content of concretions in varved sediments: Canadian Jour. Earth Sci., v. 4, no. 2, p. 333, illus., 1967.

The carbonate in concretions from two former glacial-lake locations, the Abitibi area of Quebec and northern Vermont, analysed by the method of Skinner et al (1959), was dominantly calcite, with small amounts of dolomite or slowly soluble carbonate. X-ray diffraction patterns of the noncarbonate parts were similar to those of the silty layers in which the concretions were found. The minerals were dominantly mica and chlorite, with quartz, feldspar, and amphibole present—less of the latter in the Vermont samples than those from Abitibi. The X-ray patterns for the Vermont samples were sharper and the peaks for mica and chlorite higher than in the Abitibi samples, indicating greater crystallinity of the minerals.—G.D.C.

00668 **Warnke, Detlef A.** Conditions of beach retrogression in a low-energy environment: Zeitschr. Geomorphologie, new ser., v. 11, no. 1, p. 47-61, illus., tables, 1967.

During engineering surveys on Alligator Spit in the Big Bend area of Florida, it became apparent that the beach was retrograding in excess of 6 m per year, faster than many high energy beaches. Continued surveys, made close to occurrences of hurricanes, included a dune ridge 4-5 m above sea level, a blow-out in the ridge, and the beach itself. Of three hurricanes which caused major changes, Dora, Hilda, and Betsy, the last never reached the Big Bend area; but its high-tide waves, and subsequent slumping of the over-steepened face of the forward dune apron, caused the greatest amount of retreat, and eventual collapse of the undercut seaward parts of the dune ridge. The rate of retrogression during the short period of observation is near that of the annual average; hurricane surges are a part of geomorphic processes in sub-equilibrium conditions.—G.D.C.

00787 **Wasson, John T.** The chemical classification of iron meteorites—[Pt.] 1, A study of iron meteorites with low concentrations of gallium and germanium: Geochim. et Cosmochim. Acta, v. 31, no. 2, p. 161-180, illus., tables, 1967.

Ga and Ge concentrations have been determined in 34 iron meteorites with very low Ga or Ge concentrations. All but three are either ataxites with Ni>13 percent, or fine octahedrites with Ni<9.5 percent. Ga-Ge group IV can be resolved into Ga-Ge groups IVa and IVb, with 12 and 6 members, respectively; three meteorites have Group III Ga and Ge concentrations; the other 13 cannot be assigned to any of the known Ga-Ge groups. Certain regularities in the plots of Ge versus Ga and Ge versus Ni are discussed in terms of the multiple parent-body hypothesis and planetary fractionation processes.—D.B.V.

**Watkins, Joel S.** *See* Geddes, Wilburt H. 10821

00867 **Watkins, N. D.** Comments on a paper by William H. Taubeneck, "An evaluation of tectonic rotation in the Pacific Northwest" [1966]: Jour. Geophys. Research, v. 72, no. 4, p. 1411-1414, illus., 1967.

Although the concept of secondary origin for the Columbia Arc is undoubtedly open to question, it is argued that Taubeneck's observations (ibid., v. 71, no. 8, p. 2113-2120, 1966) are insufficient grounds for rejecting that hypothesis.—D.B.V.

**Watt, A. K.** *See* Hewitt, D. F. 00850

**Watt, A. K.** *See* Hewitt, D. F. 00851

00685 **Weaver, Charles E.; Wampler, J. M.; Pecuil, T. E.** Mössbauer analysis of iron in clay minerals: Science, v. 156, no. 3774, p. 504-508, illus., table, 1967.

Mössbauer absorption spectrography can be used to establish the presence of $Fe^{2+}$ and $Fe^{3+}$ in clay minerals. In the sheet structure silicates, octahedrally coordinated iron can be distinguished from tetrahedrally coordinated iron. Siderite and goethite, common contaminants of the clay minerals, can usually be detected. Goethite has a well-organized structure, though, owing to its fine grain size, it may appear to be amorphous to X-rays. The various families of clay minerals show minor differences in isomer shift and quadrupole splitting values, caused by variations in the character of the octahedral layer.—Authors' abstract

00703 **Webb, S. David; Tessman, Norman.** Vertebrate evidence of a low sea-level in the middle Pliocene: Science, v. 156, no. 3773, p. 379, table, 1967.

Marine and untransported terrestrial vertebrates of middle Pliocene (Hemphillian) age occur together in well-sorted, sandy, phosphatic gravels at an elevation of 1.8 to 3 m in Manatee County, Fla. If no crustal warping of the Late Cenozoic age has occurred in this part of Florida (as investigators generally agree), the sea must have approached its present level 4 to 7 million years ago.—Authors' abstract

10709 **Weber, J. R.; Goodacre, A. K.** A reconnaissance underwater gravity survey of Lake Superior, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 56–65, illus., 1966.

The Bouguer anomalies on a gravity sketch map, based on 230 underwater stations [in Lake Superior], range from −90 to +25 mgal, and present a complex pattern in the western part. Those over the lake can be interpreted in terms of surface geology, the basalt producing positive anomalies, and the sedimentary rocks or granite, negative. The Keweenaw High is thought to be an extension of the Midcontinental Gravity High which is interpreted in the light of seismic studies as indicating a thick high-density crust beneath the lake. High crustal seismic velocities are consistent with generally positive gravity anomalies, indicating the presence of high-gravity rocks, but large variations in thickness determined seismically, appear to be due to rifting.—*from* Authors' abstract

**Weill, D. F.** *See* McBirney, A. R. 10873

00858 **Wells, John D.** Geology of the Eldorado Springs quadrangle, Boulder and Jefferson Counties, Colorado: U.S. Geol. Survey Bull. 1221-D, p. D1–D85, illus., tables, geol. map, 1967.

The western two-thirds of the Eldorado Springs quadrangle is underlain by Precambrian igneous and metasedimentary rocks that have been metamorphosed during three periods of deformation; the first two were plastic and the third cataclastic. Intrusion of the Boulder Creek batholith accompanied the second period and the Silver Plume Granite followed the third. Paleozoic and Mesozoic rocks flank the mountains on the east. The Laramide orogeny rotated the area by folding and faulting so that the sedimentary rocks now strike in a northerly direction and dip 40°–60° east. Pediment gravels of Pleistocene age blanket the eastern part of the quadrangle. Economic materials are virtually restricted to clay products, water, and construction materials. Gold and silver have been produced in the Magnolia district.—J.D.W.

00875 **Wells, John M.; Verhoogen, John.** Late Paleozoic paleomagnetic poles and the opening of the Atlantic Ocean: Jour. Geophys. Research, v. 72, no. 6, p. 1777–1781, illus., tables, 1967.

The Permian and Carboniferous paleomagnetic poles have been replotted using the geometrical reconstruction of the continents proposed by Bullard, Everett, and Smith [1965]. The grouping of the poles is significantly better after reconstruction for the Permian but not for the Carboniferous. It is concluded that the continental rotations deduced by those workers from the fit of the continents around the Atlantic are consistent with the paleomagnetic data.—Authors' abstract

**West, G. F.** *See* Berry, M. J. 10700

**West, G. F.** *See* Berry, M. J. 10703

**Weston, A. Argun.** *See* Innes, M. J. S. 10852

**Weyl, Peter K.** *See* Duedall, Iver W. 00814

10786 **Whetten, John T.** Geology of St. Croix, U.S. Virgin Islands, *in* Caribbean geological investigations: Geol. Soc. America Mem. 98, p. 177–239, illus., tables, geol. map., 1966.

Underlying this island are strongly folded, regionally metamorphosed Upper Cretaceous rocks, gently folded Tertiary sedimentary rocks, and Late Cretaceous or early Tertiary intrusives with contact-metamorphic aureoles. The Mount Eagle Group has interfingering sedimentary facies—epiclastic volcanic and tuffaceous—deposited in a marine environment. Sedimentary structures confirm a northerly source for the clastics; the volcanic source 10–15 miles southeast is in line with the trend of pyroclastics of similar age in Puerto Rico. The older in two generations of folds have axial planes dipping steeply north-northeast, the younger east

southeast. Two small stocks were intruded along the younger axial planes. All faults are normal except the Prosperity thrust; a central graben is covered by 7,500 feet of Tertiary rocks with only the upper part exposed. A wave-cut surface reflects Oligocene uplift.—G.D.C.

**White, George W.** *See* Winslow, John D. 10847

10706 **White, Walter S.** Geologic evidence for crustal structure in the western Lake Superior basin, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 28–41, illus., 1966.

Geologic features of Keweenawan rocks providing constraints useful to geophysical interpretations of crustal structure in the Lake Superior region include measurements of thickness and directional rates of thickening of stratigraphic units; attitudes of formations at basin margins, which can be safely projected toward the axis; and characteristics of stratified rocks providing evidence for the nature of the land surface at the time of accumulation. The composition of the sedimentary rocks suggest that, if the Keweenawan basin was a rift valley in middle and late Keweenawan time the bounding normal faults did not lie along lines of the conspicuous reverse faults now present. Thicknesses and lithofacies of the rocks suggest that the basin was formed primarily by downwarp, by loading when mafic lavas were extruded, or by crustal compression.—*from* Author's abstract

00821 **Williams, H.** (compiler). Geology, Island of Newfoundland, Newfoundland: Canada Geol. Survey Map 1231A, scale 1:1,000,000, 1967.

10692 **Willis, David E.; DeNoyer, John M.** Seismic attenuation and spectral measurements from the Lake Superior experiment, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 218–226, illus., 1966.

In detailed attenuation studies of the data, a technique was developed that permits presentation of seismic data in three dimensions—distance, frequency content, and particle velocity amplitude. Contoured iso-particle-velocity maps are thus prepared which show that many rapid changes in spectra and amplitude are part of significant trends extending from more than one shot point. Residual iso-particle velocity maps help to isolate shot anomalies and provide insight to the overall pattern of attenuation. Values of $\alpha$(absorption coefficient)=3 to $5\times10^{-4}$ sec/km and n(geometrical spreading factor)=1 or 3/2 were found to give reasonable fits to observed first compressional wave arrivals. Longer range data from 1964 shots indicated a value of $\alpha=2\times10^{-3}$ sec/km and n=3/2.—*from* Authors' abstract

**Willis, David E.** *See* DeNoyer, John M. 10694

00824 **Wilson, Charles W., Jr.; Barnes, Robert H.; McCary, Charles E. L.** Geologic map of the Aspen Hill quadrangle, Tennessee (including the Tennessee portion of the Salem quadrangle, Alabama–Tennessee): Tennessee Div. Geology Geol. Map GM 59-SE, scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Aspen Hill quadrangle, Tennessee . . .," by C. E. L. McCary (1967) is cited separately.—M.C.M.

00942 **Wilson, Charles W., Jr.** Geologic map of the Bath Springs quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 23-NE, scale 1:24,000, separate text, 1967.

Mineral resources mined in the Bath Springs quadrangle are limestone, sand and gravel, chert, iron ore, and phosphate. Limestones of several formations are sources of aggregate, dimension stone, and cement rock. Extensive deposits of Quaternary sand and gravel up to 60 feet thick are available. Chert beds in the Fort Payne Formation are from one to ten inches thick, those in the Harriman Formation from two to six inches. Brown iron ore was mined extensively before the Civil War

but was of relatively low grade and had a high phosphorus content. Little phosphate has been mined since 1903.—M.C.M.

10807 **Wilson, J. Tuzo.** Patterns of growth of ocean basins and continents, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 388-391, illus., 1966.

The geology of ocean floors differs greatly from that of continents in age, petrology, types of faulting, ore deposits, seismicity, and in the associated systems of mountains and ridges. These differences resemble those between the surface of a fluid convecting in a cauldron which is renewed like the ocean floors, and the islands of froth or slag that collect like continents. The tectonic pattern of continents is due to marginal growth distributed by the periodic breaking up and reassembly of continental blocks. The pattern on the ocean floor reveals the flow in the upper mantle which seems to take the form of a single complex cell.—Author's abstract

10736 **Wilson, Thomas A.; Mero, John L.** Economic deposits of the California offshore area, *in* Geology of northern California: California Div. Mines and Geology Bull. 190, p. 343-353, illus., table, 1966.

The beach and nearshore areas of the California coast are favorable zones for the occurrence of black sand and precious metal placers. The continental shelf and slope are known to contain authigenic materials of commercial interest such as glauconite and phosphorite, as well as large reserves of petroleum and natural gas. The deep-sea floor contains extensive deposits of manganese and other metals in the form of nodules. Only petroleum is being recovered on a large scale today.—Authors' introduction

00879 **Wing, Charles G.** An experimental deep-sea-bottom gravimeter: Jour. Geophys. Research, v. 72, no. 4, p. 1249-1257, illus., table, 1967.

An experimental automatic sea-bottom gravimeter, in which an inertial guidance vibrating-string accelerometer is used, has been constructed. Use of the instrument in its different modes should provide criteria for future bottom gravimeters as well as significant geophysical information. Initial tests indicate that the useful accuracy is limited by the free-air and latitude corrections. The precision of the instrument is about 0.5 mgal.—Author's abstract

10847 **Winslow, John D.; White, George W.** Geology and ground-water resources of Portage County, Ohio: U.S. Geol. Survey Prof. Paper 511, 80 p., illus., tables, geol. map, 1966.

The best consolidated-rock aquifers in Portage County are the sandstone members of the Pennsylvanian Pottsville Formation; of these the Sharon has the greatest areal extent, thickness, and permeability, with wells yielding to 200 gpm. Glacial drift fills the complex pattern of buried valleys and where it is composed of coarse sand and gravel, wells have yielded as much as 1,200 gpm; in other buried-valley areas where deposits are fine sand, silt, and clay, yields are poor. Chemical quality of water from both sandstones and glacial drift is satisfactory for most purposes. Plates in pocket include a bedrock geologic map and sections, maps of glacial deposits and ground-water sources, graphic logs of water and test wells, and a map showing location of water and test wells, oil and gas wells, and seismic sites.—M.C.M.

10710 **Wold, Richard J.; Ostenso, Ned A.** Aeromagnetic, gravity, and sub-bottom profiling studies in western Lake Superior, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.-Natl. Research Council Pub. 1467), p. 66-94, illus., table, 1966.

About 7,500 mi of north-south aeromagnetic tracks were flown, 275 bottom gravity stations occupied, and 900 mi of sub-bottom seismic profiles obtained [in western Lake Superior]. The magnetic and gravity surveys support the structural interpretation of White for the far western part and indicate a medial ridge, extending southwestward from the western end of Isle Royale, that divides the area east of the Bayfield Peninsula into the north and south basins. The north basin

is cut by a fault extending east and west, running north of Isle Royale; another extends from St. Ignace to the eastern end of Isle Royale. The sub-bottom profiles show details such as sediment-filled troughs and old stream channels.—*from* Authors' abstract

10730 **Wolfe, C. Wroe.** Energy, time, and physical morphology, *in* Planetology and space mission planning—Sec. 1, Environments: New York Acad. Sci. Annals, v. 140, art. 1, p. 16–34, illus., 1966.

Most of the Earth's solar energy complement is not available for work affecting morphology of the lithosphere surface. The hydrologic cycle is initiated by solar energy. Gravitational energy is derived from either the Sun's contributions or contributions from within the Earth. On the lithospheric surface, the first-order variation is the equatorial bulge; second-order relief features include continents and ocean basins, whose origin is an unsolved problem; and third order features are linear deeps and island arcs, or nonlinear domes and basins. The convection hypothesis has been suggested as a cause for these but Wolfe believes the requisite heat is not present at depth and that these features are related to the radioactive lithosphere, involving motions of the Moho.—E.S.L.

**Wolfskill, L. A.** *See* Herrmann, H. G. 10918

00823 **Woodrow, P. J.** The crystal structure of astrophyllite: Acta Cryst., v. 22, pt. 5, p. 673–678, illus., tables, 1967.

The mineral astrophyllite is triclinic. The *A*-face-centred unit cell chosen has parameters $a = 5.36$, $c = 21.08$ A, $\alpha = 85°08'$, $\beta = 90°00'$, $\gamma = 103°13'$ and contains two formula units. The projection of the structure along the $x$ axis has been determined from $Okl$ data. The structure is closely related to that of biotite mica but contains octahedrally coordinated titanium in the 'tetrahedral' layer. [Specimen used is from El Paso County, Colorado].—*from* Author's abstract

10680 **Woollard, G. P.** Regional isostatic relations in the United States, *in* The earth beneath the continents—A volume of geophysical studies in honor of Merle A. Tuve: Am. Geophys. Union Geophys. Mon. 10 (Natl. Acad. Sci.–Natl. Research Council Pub. 1467), p. 557–594, illus., tables, 1966.

Isostatic gravity anomaly relations are examined on a regional basis and shown on eight east–west and one north–south transcontinental profiles. In the shield area, major basins are marked by positive anomalies, and uplifts by negative, but in the Rocky Mts. and westward, the reverse is true. Changes in mean crustal density would explain relations noted in the midcontinent, but in the west, basins and uplifts are physically displaced from equilibrium position. Granitic plutons, the Colorado Plateau, and Basin and Range province, are characterized by negative anomaly values. Seismic measurements suggest that regions of positive anomalies are associated with abnormal crustal thickness and negative anomalies with subnormal thickness. There is no single universal mechanism governing isostasy. Mass distribution at depth appears to range from that of the Airy–Heiskanen theory to that in the Pratt–Hayford concept.—E.S.L.

10801 **Woollard, G. P.** Crust and mantle relations in the Hawaiian area, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 294–310, illus., 1966.

Geophysical studies over the Hawaiian ridge, trench, and rise indicate significant differences in crustal structure and thicknesses. Mantle depth changes from 21 km beneath the ridge between Oahu and Molokai, to 15 km beneath the trench, to 10 km beneath the rise north of Molokai; corresponding change in free-air gravity anomaly values are +190 mgal, −100 mgal, +30 mgal, respectively. Magnetic anomalies appear only over volcanic centers, rifts, and the Molokai fracture zone; seismic measurements indicate material with velocities of 7.6–8.0 kmps at depths 2–6 km below sea-level. These patterns over volcanic centers are characteristic throughout the islands. The ridge is fracture controlled and the trench and rise secondary features induced by subsidence beneath the load of volcanics. The shallow

Moho depth (9–10 km) on the rise is due to crustal flexure, not subnormal crustal thickness.—*from* Author's abstract

**Woollard, George Prior.** *See* Malahoff, A. 10864

10804 **Worzel, J. Lamar.** Structure of continental margins and development of ocean trenches, *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66–15, p. 357–375, illus., 1966.

The transition from continent or island ridge to ocean basin occurs in a distance of about 100 to 150 km. Crustal thickness beneath continents and island ridges is normally 20–30 km and thins to oceanic crustal thicknesses (5–7 km) with the most abrupt change occurring beneath the 2,000 m contour. Trenches normally form in this transition zone, either by graben faulting or normal faulting on the landward side and a flexure on the seaward side. Downdropping the trench block by 2–4 km produces the topographic and gravitational features of the trench. The shape is controlled by the shape of the coastal margin along which this process occurs. Formation of a trench can be contemporaneous with development of the nearby coastal margin, but in many cases is probably a much later development. Such a feature is now forming along the northeastern margin of the Hawaiian Islands.—*from* Author's abstract

**Wright, Frances W.** *See* Hodge, Paul W. 00776

**Wright, T. L.** *See* Decker, R. W. 10866

00732 **Wright, Thomas L.** The microcline–orthoclase transformation in the contact aureole of the Eldora stock, Colorado: Am. Mineralogist, v. 52, nos. 1–2, p. 117–136, illus., tables, 1967.

Feldspars from pegmatites in Precambrian gneiss within 2,770 feet of a Tertiary quartz monzonite stock near Eldora, Colo., were transformed from maximum microcline to orthoclase by contact metamorphism. In the range 2,770 to 1,130 feet a monoclinic and a triclinic potassic phase coexist in perthitic intergrowth with albite of low–intermediate structural state. At greater distances perthites consisting of maximum microcline and low albite were unaffected, and at shorter distances the samples are composed of orthoclase and intermediate albite. Data of this study combined with the work of Steiger and Hart place the upper stability limit of maximum microcline on the binary Or–Ab solvus at 375° ± 50°C . . .—*from* Author's abstract

**Wyllie, P. J.** *See* Boettcher, A. L. 00661

**Wyllie, P. J.** *See* VanGroos, A. F. Koster, 10740

**Yagi, Kenzo.** *See* Onuma, Kosuke, 00726

00628 **Yalkovsky, Ralph.** Time series analysis of Caribbean deep sea core A 172–6: Jour. Geology, v. 75, no. 2, p. 224–231, illus., tables, 1967.

The core of foraminiferal lutite was spectrochemically analyzed for Fe, MnO, CaO, MgO, $TiO_2$, $Al_2O_3$, and $SiO_2$; these and carbonate content are compared with published paleotemperature data. By a statistical time series test, a trend in this core is indicated for all these elements and paleotemperature, suggesting stability during the Pleistocene, 60,000–80,000 years before present. Sources of uncertainty in this test are those inherent to the test itself, and also the post-depositional solution of the cored sediment.—V.E.S.

00649 **Yalkovsky, Ralph.** Signs test applied to Caribbean deep sea core A 172–6: Science, v. 155, no. 3768, p. 1408–1409, tables, 1967.

Caribbean core A 172–6 of the Lamont Geological Observatory series has been subjected to a nonparametric test for trend in order to examine the distribution of selected elements [Al, Si, Fe, Ti, Ca, Mg, Mn] and of published paleotemperature

data throughout a core length of 0.35 m. First appearance of trend below top of core has been calculated, and the results of these tests are discussed.—Author's abstract

**Yarbrough, Lavern A.** *See* Conway, William, 10895

00641 **Yerkes, R. F.; Castle, R. O.** Engineering geology aspects, *in* The Parkfield-Cholame, California, earthquakes of June-August 1966: U.S. Geol. Survey Prof. Paper 579, p. 40–53, illus., 1967.

The main shock of the Parkfield-Cholame earthquake at 9:26 on June 27, 1966 (P.d.t.) produced a zone of en echelon tectonic fractures at least 23 1/2 mi long following well-defined previously recognized fault traces. A right-lateral offset of about 1.8 inches occurred near the south end of the main fracture where a short-duration horizontal acceleration of 0.5 g was measured. Intensity VIII to IX effects were noted in a narrow band along the fracture zones. Such effects are commonly associated with shocks of about M = 7 and suggest that the potential destructiveness of moderate magnitude earthquakes should be reappraised. Creep and ground movement continued along the main fracture zone for at least seven weeks. The modest damage that resulted from both direct and indirect effects was due to the narrowness of the zone of effects and to the sparseness of manmade structures.—V.S.N.

**Young, J. Fred.** *See* Greenman, Norman N. 00783

00857 **Zen, E-an.** Construction of pressure-temperature diagrams for multicomponent systems after the method of Schreinemakers—A geometric approach: U.S. Geol. Survey Bull. 1225, 56 p., illus., tables, 1967.

The topologic relations of p-T diagrams for $n$-component, in-, uni-, and di-variant equilibria directly reflect the chemographic relations of the $n+2$ participating phases and can be deduced therefrom by a geometric approach. The dispositions of these equilibria are the projections onto p-T planes of the intersections of Gibbs free energy surfaces of divariant phase assemblages. All possible degenerate phase relations for $n$ of 1,2,3 are derived; each distinct degeneracy reduces by one the number of distinct univariant slope values at the invariant point. The concept of intersection of free energy surfaces allows the prediction of sequences of metastable assemblages in binary systems; this is an extension of the "Oswald step rule."—E.Z.

10812 **Zietz, Isidore; King, Elizabeth R.** Crustal study along a transcontinental great circle from Washington, D. C., to San Francisco, Calif., *in* Continental margins and island arcs—Internat. Upper Mantle Comm., Symposium, Ottawa, 1965: Canada Geol. Survey Paper 66-15, p. 445–452, illus., 1966.

The North American continent has been spanned by a strip of twenty continuous aeromagnetic profiles spaced five miles apart which not only reflect gross lithology and structural trends in the magnetic rocks of the crystalline basement, but also indicate a fundamental difference between the crust to the east of the Rocky Mountains and the crust to the west. This crustal contrast is supported by the results of recent seismic refraction studies and shows a good correlation with the available heat-flow data, particularly when the magnetic data are filtered to remove the short wavelength anomalies caused by inhomogeneities in the upper part of the crust.—Author's abstract

10729 **Zoeller, W. A.** Dual porosity logging—A means to better evaluation of porosity and lithology in the Permian Basin: Log Analyst, v. 6, no. 5, p. 50–59, illus., 1966.

Dual porosity logging records reservoir information in a simplified form, and enables simultaneous recording of linear porosities from acoustic and epithermal-neutron devices, with gamma ray and caliper curves. It makes possible comparison of both acoustic and epithermal-neutron response normalized to a common linear porosity scale. Anomalous departures between "dual porosity" curves become guides for identification of particular lithologies and types of porosities. The limitation of each porosity device, when used singularly, becomes an advantage when studied in conjunction with the companion porosity curve. Field examples of dual porosity

logging compared with core studies show the validity and utility of this new technique.—*from* Author's abstract

# INDEX

[The numbers refer to entries in the abstracts]


**Absolute age, dates**
*Basalt*
Hawaii, Oahu, K-Ar: Stearns, Harold, 10732
*Carbon-14*
Alaska, spruce pollen, Pribilofs, late Wisconsin land bridge: Colinvaux, Paul A, 00700
Florida, southern, peat: Scholl, David W, 00682
Massachusetts, North Truro quadrangle, marine shells: Koteff, Carl, 00829
Yukon, Saint Elias Mts., glacial chronology: Denton, George H, 00691
*Granitic rocks*
Alaska, southeastern, Mesozoic, Tertiary events: Loney, Robert A, 00690
United States, southwestern: Moorbath, S, 00795
*Igneous rocks*
Colorado, Front Range, northern: Hedge, Carl E, 00687
*Interpretation*
Mica: Rimsaite, J. H. Y, 00900
Model age cf. rock age, granitic rocks, North America: Tilton, George R, 10851
*Metamorphic rocks*
Colorado, Front Range, northern, whole rock: Hedge, Carl E, 00687
Minnesota, Morton Gneiss, discordant Pb-U, cause: Stern, T. W, 10793
Minnesota, Morton Gneiss, biotite, weathering effect: Goldich, S. S, 10891
*Sediments*
California, Cayucos invertebrates, marine Pleistocene: Veeh, H. Herbert, 00688
**Absolute age, methods**
*Potassium-argon*
Mica, feldspar, reliability: Livingston, Donald E, 00680
Volcanic rocks, fluid inclusions as source of anomalies: Funkhouser, J. G, 10863
*Uranium-lead*
Discordant ages, zircon, weathering factor: Stern, T. W, 10793
Zircon, isotopic stability: Pidgeon, R. T, 10725
**Alaska**
*Absolute age*
Pribilofs, spruce pollen, C-14, late Wisconsin land bridge: Colinvaux, Paul A, 00700
Southeastern, granitic plutons, Mesozoic, Tertiary events: Loney, Robert A, 00690
*Areal geology*
Iniskin-Tuxedni region: Detterman, Robert L, 00648
*Earthquakes*
March 28, 1964, aftershocks, shear-type recovery: Chouhan, R. K. S, 10776
March 1964, atmospheric waves: Row, Ronald V, 00801
*Geomorphology*
Physiographic regions, textbook: Hunt, Charles B, 00790
**Alaska**
*Geophysical surveys*
Aleutian Islands arc, seismic: Shor, George C., Jr, 10814
Coastal area, crustal structure, seismic: Hales, A. L, 10699
Crustal studies, seismic, history: Tuve, Merle A, 10698
Northern, continental margin, seismic, magnetic: Hunkins, Kenneth, 10818
*Maps, geologic*
Iniskin-Tuxedni region: Detterman, Robert L, 00648
*Maps, geomorphologic*
Land-surface form: Hammond, Edwin H, 10926
*Maps, tectonic*
Alaska Peninsula and Cook Inlet region: Detterman, Robert L, 00648
*Paleontology*
Cephalopoda, Cretaceous, *Tetragonites*, taxonomy, new species: Murphy, Michael A, 00877
Palynomorphs, Pleistocene, Pribilofs, lake core: Colinvaux, Paul A, 00700
Pelecypoda, Mesozoic, northern, east-central, monotids: Imlay, Ralph W, 00644
*Structural geology*
Aleutian arc, continental margin, evolution: Burk, C. A, 10800
Aleutian Islands arc: Shor, George C., Jr, 10814
**Alberta**
*Geophysical surveys*
Rocky Mountains, southern, seismic: Bally, A. W, 10716
*Glacial geology*
Banff area, multiple glaciation: Rutter, N. W, 10912
Iosegun Lake area, eastern, periglacial features: Saint-Onge, D. A, 00904
*Maps, geologic*
Iosegun Lake area, eastern, surficial: Saint-Onge, D. A, 00904
*Stratigraphy*
Cambrian, Rocky Mts.: Norris, D. K, 10903
Cambrian to Ordovician, Rocky Mts.: Aitken, J. D, 10911
Precambrian-Ordovician, Jasper area: Slind, O. L, 10910
*Structural geology*
Rocky Mountains, southern, general: Bally, A. W, 10716
**Algae**
*Prochamaesiphon cummingsi, n.gen.n.sp.*
Ordovician, Illinois, in ectoproct bryozoan: Elias, Maxim K, 10723
*Prochamaesiphon geitleri, n.gen.n.sp.*
Pennsylvanian, Nebraska, in ectoproct bryozoan: Elias, Maxim K, 10723
**Aluminum**
*Analysis*
Activation: Eichholz, Geoffrey G, 00747

**Anthozoa**
*Mississippian*
Wyoming, Madison Limestone, assemblage: Sando, W. J. 00678
**Appalachians**
*Paleomagnetism*
Paleozoic, anisotropy, relation to structure: Graham, John W. 10684
*Structural geology*
Magnetic susceptibility anisotropy, relation: Graham, John W. 10684
**Arctic Ocean**
*Geophysical surveys*
Chukchi Cap, magnetic anomaly: Hunkins, Kenneth. 10818
*Structural geology*
Crust, relation to North America, continental margin: Roots, E. F. 10817
**Argon**
*Isotopes*
Ar 40, retentivity in feldspars: Livingston, Donald E. 00680
**Arizona**
*Absolute age*
Mineralized intrusives: Moorbath, S. 00795
*Geochemistry*
Grand Canyon region, Cenozoic basalts, chemical variations: Best, Myron G. 00654
*Maps, geologic*
Mammoth quadrangle: Creasey, S. C. 00859
*Paleontology*
Porifera, Permian, Kaibab Limestone, northern: Griffin, Leland R. 00655
*Petrology*
Grand Canyon region, Cenozoic basalts, mineral variations: Best, Myron G. 00654
Santa Catalina Mountains, Leatherwood Quartz Diorite, inclusions: Hanson, H. S. 00743
*Stratigraphy*
Mammoth quadrangle: Creasey, S. C. 00859
*Structural geology*
Mammoth quadrangle: Creasey, S. C. 00859
**Arkansas**
*Hydrogeology*
Grand Prairie area: Johnson, A. I. 10713
Pulaski, Saline Counties, water resources: Plebuch, Raymond O. 00932
*Maps, ground water*
Pulaski, Saline Counties: Plebuch, Raymond O. 00932
*Sedimentary petrology*
Ouachita Mountains, Athens Plateau, flysch deposits: Walthall, Bennie H. 00676
*Stratigraphy*
Pennsylvanian Mississippian, Ouachita Mts., Athens Plateau: Walthall, Bennie H. 00676
*Structural geology*
Ouachita Mountains, Athens Plateau, folds, faults: Walthall, Bennie H. 00676
**Associations**
*Am. Soc. Testing and Materials*
Symposium, rock mechanics, testing techniques: Am. Society for Testing and Materials. 10924
**Associations**
*Commission on Ore Microscopy*
England, Cambridge, Aug.-Sept. 1966: Bowie, S. H. U. 00798
*Denver Research Institute*
Conference, applications of X ray analysis: Mallett, Gavin R. 10925
*Society of Economic Geologists*
Problems: Gustafson, J. K. 00794
**Atlantic Ocean**
*Geochemistry*
Carbonate sediment, element distribution, paleotemperature: Wangersky, Peter J. 00632
*Geophysical surveys*
Bahama Islands-Puerto Rico trench area, magnetic anomaly: Geddes, Wilburt H. 10821
Blake Outer Ridge, seismic: Andrews, James E. 00809
Blake Plateau, seismic: Ewing, J. I. 10822
Puerto Rico trench, seismic profiles: Bunce, Elizabeth T. 10799
Puerto Rico trench to Nares Deep, seismic: Hersey, J. B. 10798
*Paleomagnetism*
Carboniferous, Permian, continental rotations: Wells, John M. 00875
*Structural geology*
Blake Outer Ridge, gravity tectonics: Andrews, James E. 00809
Greenland basin, crust: Demenitskaya, R. M. 10796
Puerto Rico trench: Bunce, Elizabeth T. 10799
**Automatic data processing**
*Economic geology*
Computer simulation, correlation, sampling of ores: Hazen, Scott W., Jr. 10855
*Explosion phenomena*
Crater growth, computer calculation technique: Cherry, J. T. 00803
*Geochemical prospecting*
Coding system, data cards: Gleeson, C. F. 00927
*Petroleum exploration*
Advantages: Rivette, J. F. 00716
*Remote sensing methods*
Airborne systems: Barringer, A. R. 10887
Infrared, rock, soil compositions: Lyon, R. J. P. 10886
*Seismic surveys*
Refraction data, iterative process, time-term equation solution: Mereu, R. F. 10690
**Barium**
*Abundance*
Sea water, Atlantic, cf. Pacific and Mediterranean: Chow, Tsaihwa J. 10784
**Basins, structural**
*Evolution*
Ocean basins, growth patterns: Wilson, J. Tuzo. 10807
*Mechanism of formation*
Lake Superior basin, western: White, Walter S. 10706

**Biogeochemical prospecting**
*Soil sampling*
Humus, A horizon: Boyle, R. W. 00797
**Biography**
*Fisher, Joel Ellis*: Putnam, William L. 00686
*Lucas, Elmer Lawrence*: Merritt, Clifford A. 00659
*Patterson, Arthur Lindo*: Marsh, R. E. 00820
**Brachiopoda**
*Devonian*
Canada, western, correlation: Crickmay, C. H. 00861
*Devonian–Mississippian*
Montana, Sappington Formation, western, fauna: Gutschick, R. C. 00677
*Mississippian*
Wyoming, Madison Limestone, assemblage: Sando, W. J. 00678
*Silurian–Devonian*
Yukon, faunal units: Lenz, A. C. 10913
*Tylothyris clarksvillensis*
Mississippian, Montana, Sappington Formation: Gutschick, R. C. 00677
**British Columbia**
*Geophysical surveys*
Rocky Mountains, southern, seismic: Bally, A. W. 10716
*Stratigraphy*
Cambrian, Rocky Mts.: Norris, D. K. 10903
Ordovician, Glenogle Formation, graptolite zones: Larson, M. L. 10916
Ordovician–Silurian, graptolitic facies: Jackson, D. E. 10909
Permian, Isbel Group, Peace River area, Mt. Greene: McGugan, Alan. 00889
Precambrian–Ordovician, Pine River area: Slind, O. L. 10910
Silurian, Nonda Formation, new, Rocky Mountains: Norford, B. S. 10915
*Structural geology*
Rocky Mountains, southern, general: Bally, A. W. 10716
**Bryozoa**
*Ectoprocta*
Ordovician, Pennsylvanian, infested by algae and fungi: Elias, Maxim K. 10723
**California**
*Absolute age*
Pleistocene invertebrates, Cayucan faunal province: Veeh, H. Herbert. 00688
*Areal geology*
Northern, guidebook: Bailey, Edgar H. 10763
Sacramento Valley, northern Coast Ranges, field trip road log: Emerson, D. O. 10746
San Francisco area, field trip: Bonilla, M. G. 10743
San Francisco area, field trip, Golden Gate to Greenbrae: Galloway, Alan J. 10762
Santa Ynez Mountains region, central: Dibblee, T. W., Jr. 10813
Sierra Nevada Range: Bateman, Paul C. 10768
*Earthquakes*
June 28, 1966, Parkfield, stress drop at source: Aki, Keiiti. 00802
**California**
*Earthquakes*
June–August 1966, Parkfield–Cholame: Brown, Robert D., Jr. 00638
June–August 1966, Parkfield–Cholame, damage: Yerkes, R. F. 00641
June–August 1966, Parkfield–Cholame, fractures: Brown, Robert D., Jr. 00639
June–August 1966, Parkfield–Cholame, progressive deformation: Wallace, Robert E. 00629
June–August 1966, Parkfield–Cholame, seismic studies: Eaton, Jerry P. 00640
June–August 1966, Parkfield–Cholame, water resources effects: Waananen, A. O. 00642
*Economic geology*
Metals, Klamath Mountains: Albers, John P. 10766
Mineral resources, Coast Ranges: Davis, Fenelon F. 10754
Mineral resources, Great Valley: Hart, Earl W. 10749
Mineral resources, northeastern: Gay, Thomas E., Jr. 10767
Mineral resources, offshore deposits: Wilson, Thomas A. 10736
Mineral resources, Sierra Nevada: Clark, William B. 10772
Phosphate, Coast Ranges, occurrence, Tertiary: Dickert, Paul F. 10752
*Engineering geology*
Aqueducts, San Andreas fault crossings: Arnold, A. B. 00923
Land subsidence, Great Valley: Poland, J. F. 10734
Land subsidence, San Jacinto Valley, bordering faults: Fett, John D. 00929
Shorelines, Point Arguello area, sediment transport: Bowen, A. J. 10777
Solution cavity location, Cool area, geophysical methods: Love, Colin L. 00912
*Geochemistry*
Water, ground, surface, sea, trace elements: Silvey, William D. 00897
*Geomorphology*
Cache Creek basin, sediment transport: Lustig, Lawrence K. 00906
*Geophysical surveys*
Continental margin, acoustic profiling: Curray, Joseph R. 10756
Cool area, solution cavity location, electrical, seismic: Love, Colin L. 00912
Northern, gravity, summary: Chapman, Rodger H. 10735
Northern, magnetic, airborne: Griscom, Andrew. 10760
Sierra Nevada and Coast Ranges, seismic, refraction profile: Eaton, Jerry P. 10761
Southern, continental shelf, seismic: Moore, David Gillis. 10859

**California**
*Hydrogeology*
Alamitos Gap, salt water intrusion, water barrier construction: Johnson, Michael. 00882
East Bay area and northern Santa Clara Valley, field trip road log: Davis, S. N. 10745
Great Valley, ground water resources: Poland, J. F. 10734
Parkfield Cholame area, 1966 earthquake effects: Waananen, A. O. 00642
*Maps, geologic*
Cache Creek drainage basin: Lustig, Lawrence K. 00906
History, State maps: Jennings, Charles W. 10764
Santa Ynez Mountains, central, six quadrangles: Dibblee, T. W., Jr. 10813
*Marine geology*
Continental margin, structure: Curray, Joseph R. 10756
Continental margin, structure: Rusnak, Gene A. 10755
Ecology, Tomales Bay, intertidal beach sands, salinity: Johnson, Ralph Gordon. 00819
*Mineralogy*
Allophane, Mariposa County, secondary origin: Snetsinger, Kenneth G. 00728
*Paleontology*
Echinodermata, Cambrian, new helicoplacoid genera and species: Durham, J. Wyatt. 00771
Foraminifera, Cenozoic, upper, *Globorotalia pachyderma*: Jenkins, D. Graham. 00855
Foraminifera, San Emigdio Formation, Mollusca, Kern County: DeLise, K. C. 00779
Mollusca, Pliocene, Siesta Formation, Berkeley Hills: Firby, James R. 00899
Pelecypoda, Mesozoic, Pliensbachian, eastern, new monotid: Imlay, Ralph W. 00644
Pelecypoda, Tertiary, *Platyodon, Penitella*: Adegoke, Oluwafeyisola S. 00898
*Petrology*
Cascade Range and Modoc Plateau, volcanics: Macdonald, Gordon A. 10737
Coast Ranges, Salinian block: Compton, Robert R. 10751
Klamath Mountains, metamorphic facies, granitic intrusives: Davis, Gregory A. 10738
Yosemite Park, Sierra Nevada batholith, field trip road log: Peck, Dallas L. 10747
*Stratigraphy*
Cascade Range and Modoc Plateau: Macdonald, Gordon A. 10737
Coast Ranges, core complexes: Page, Ben M. 10750
Cretaceous, Upper, northern, unconformity: Peterson, Gary L. 00679
Franciscan Formation, field trip road log: Bonilla, M. G. 10743

**California**
*Stratigraphy*
Great Valley: Hackel, Otto. 10748
Paleozoic Mesozoic, Klamath Mts.: Irwin, William P. 10765
Paleozoic Mesozoic, Sierra Nevada, Taylorsville area, revision: McMath, Vernon E. 10769
Quaternary, Coast Ranges: Christensen, Mark N. 10753
Santa Ynez Mountains, Eocene series, correlation: Stauffer, Peter H. 00643
Tertiary, San Emigdio Formation, Kern County: DeLise, K. C. 00779
Tertiary, volcanics, Sierra Nevada, central: Slemmons, David B. 10771
Tertiary Quaternary, Sierra Nevada, northern: Durrell, Cordell. 10770
*Structural geology*
Cascade Range and Modoc Plateau: Macdonald, Gordon A. 10737
Coast Ranges and San Andreas fault, strain analysis: Burford, Robert O. 10853
Coast Ranges, orogenic history: Page, Ben M. 10750
Coast Ranges, San Andreas fault system: Oakeshott, Gordon B. 10757
Contra Costa County, Calaveras fault zone, movement: Saul, Richard B. 00697
Great Valley: Hackel, Otto. 10748
Klamath Mountains: Irwin, William P. 10765
Klamath Mountains, tectonic provinces: Davis, Gregory A. 10738
Northern, magnetic data: Griscom, Andrew. 10760
Riverside County, Casa Loma, San Jacinto faults, displacement: Fett, John D. 00929
San Andreas fault, cumulative offset: Dibblee, T. W., Jr. 10758
San Andreas fault, displacements: Crowell, John C. 10842
San Andreas fault, movement: Meade, Buford K. 10878
San Andreas fault, recent movement: Meade, Buford K. 10759
San Francisco Peninsula, San Andreas fault: Brabb, Earl E. 10744
Sierra Nevada, Taylorsville area: McMath, Vernon E. 10769
*Weathering*
Mariposa County, plagioclase in granodiorite: Snetsinger, Kenneth G. 00728

**Cambrian**
*Alberta*
Jasper area, stratigraphy: Slind, O. L. 10910
Rocky Mountains, cyclic sedimentation: Aitken, J. D. 10911
Rocky Mountains, Middle, stratigraphy: Norris, D. K. 10903
*British Columbia*
Pine River area, stratigraphy: Slind, O. L. 10910
Rocky Mountains, Middle, stratigraphy: Norris, D. K. 10903

**Cambrian**
*California*
East central, Echinodermata, new helicoplacoid genera and species: Durham, J. Wyatt. 00771
*General*
Echinodermata, Helicoplacoidea, taxonomy, morphology: Durham, J. Wyatt. 00771
*Georgia*
Bartow County, Conasauga Group: Smith, James W. 00863
Floyd County, Mollusca, Conasauga shale, hyolithid fauna: Englebright, Steven C. 00864
**Canada**
*Engineering geology*
Mesoscopic geology structures, active in failure, coal mines: Norris, D. K. 10832
*Geophysical surveys*
Eastern coast, seismic, gravity: Dainty, A. M. 10687
Eastern, continental margin, crust, seismic: Keen, M. J. 10742
Eastern, continental shelf, magnetic: Hood, Peter. 10739
*Mineralogy*
Mica, rock forming types: Rimsaite, J. H. Y. 00900
*Paleontology*
Invertebrata, Devonian, use in correlation: Crickmay, C. H. 00861
*Stratigraphy*
Cordilleran region, northern, depositional sequences: Gabrielse, H. 00895
Paleozoic, Cretaceous(?), Hudson Bay basin: Nelson, S. J. 10914
*Structural geology*
Cordilleran region, northern, tectonic evolution: Gabrielse, H. 00895
Precambrian shield, uplift, relation to gravity field: Innes, M. J. S. 10852
Recent crustal movements: Meade, Buford K. 10878
**Carbon**
*Abundance*
Enstatite chondrites: Moore, Carleton B. 10794
**Caribbean region**
*General*
Current research, Princeton Univ. Dept. Geology: Hess, H. H. 10790
*Geophysical surveys*
Gravity anomaly belts: Talwani, Manik. 10728
Lesser Antilles island arc, seismic: Hurley, Robert J. 10797
*Structural geology*
Island arc, tectonics, evolution: Hamilton, Warren. 10816
Island arc theories, Princeton Univ. project: Hess, H. H. 10790
**Caribbean Sea**
*Geochemistry*
Carbonate sediment, analyses, cf. paleotemperature: Yalkovsky, Ralph. 00628
Carbonate sediment, element distribution, paleotemperature: Wangersky, Peter J. 00632
Sediment core, element distribution trend, sign test: Yalkovsky, Ralph. 00649
*Geomorphology*
Bottom features: Hess, H. H. 10790
*Maps, geomorphologic*
Bathymetric chart: Hess, H. H. 10790
*Structural geology*
Crust, seismic studies: Hersey, J. B. 10798
**Caves**
*Arizona*
Grand Canyon area, Stanton Cave, pirated spring: Reilly, P. T. 00901
*Missouri*
Springfield Branson area, guidebook: Vineyard, Jerry D. 00807
**Cenozoic**
*California*
Santa Ynez Mountains region, stratigraphy: Dibblee, T. W., Jr. 10813
*Georgia*
East central, coastal plain sediments: Carver, Robert E. 00862
*Pacific Ocean*
Tropics, sediments, Radiolaria: Friend, Jennifer K. 00856
**Central America**
*Petrology*
Rhyolite, magma genesis: McBirney, A. R. 10873
**Cephalopoda**
*Tetragonites*
Cretaceous, Aptian Cenomanian, taxonomy, evolution, new species: Murphy, Michael A. 00877
**Cesium**
*Manitoba*
Bernic Lake pegmatite, reserves: Howe, A. C. A. 00813
**Changes of level**
*Rates*
Florida, southern cf. adjacent coastal areas: Scholl, David W. 00682
Manitoba, Churchill area: Barnett, D. M. 10893
**Chemical analysis**
*Wet*
Phosphate minerals, organic dyes and strychnine molybdate reagent: Kittrick, J. A. 00729
**Chlorine**
*Geochemistry*
Loss, silicic volcanic rocks, crystallized or glassy: Noble, Donald C. 00705
**Chromite**
*Montana*
Stillwater Complex: McDonald, J. A. 00799

**Clay mineralogy**
*Areal studies*
Georgia, Altamaha River flood plain, coastal area: Jinks, D. D. 00745
Missouri, western, Pennsylvanian, lower Cabaniss underclays: Tennissen, Anthony C. 00808
Nevada, Ely, paragenesis: Fournier, Robert O. 00793
Nevada, Ely, paragenesis: Fournier, Robert O 00653
West Indies, soils, geomorphologic units, engineering classification: Beaven, P. J. 10917
*Experimental studies*
Aluminian montmorillonoid, interstratified, synthesis: Granquist, W. T. 00725
Kaolinite, dehydroxylation characteristics, rate: Brindley, G. W. 00707
Mossbauer analysis of iron: Weaver, Charles E. 00685
Smectites and vermiculites, organic complexes, review: Brindley, G. W. 10927
*Mineral data*
Allophane, secondary origin, California: Snetsinger, Kenneth G. 00728
Kaolinite, isothermal dehydroxylation: Brindley, G. W. 00707
Montmorillonoid, interstratified aluminian, synthesis: Granquist, W. T. 00725
Vermiculite, hydrobiotite, Montana: Boettcher, A. L. 10908

**Clays**
*Missouri*
Western, lower Cabaniss Subgroup, ceramic properties: Tennissen, Anthony C. 00808
*Montana*
Uses, testing: Chelini, J. M. 10783
*Tennessee*
Boyds Creek quadrangle, resources: Swingle, George D. 00922

**Coal**
*Kentucky*
Fallsburg quadrangle, resources: Sharps, Joseph A. 00839
West Liberty quadrangle, resources: Englund, Kenneth J. 00650
*Montana*
Great Falls–Lewistown field, reserves, occurrence: Silverman, Arnold J. 00853
*Utah*
Escalante–Upper Valley area, occurrence: Doelling, Hellmut H. 00815

**Colorado**
*Absolute age*
Front Range, northern, Precambrian regional metamorphism: Hedge, Carl E. 00687
Mineralized intrusives: Moorbath, S. 00795
*Areal geology*
Bristol Head quadrangle: Steven, Thomas A. 00834
Eldorado Springs quadrangle: Wells, John D. 00858

**Colorado**
*Economic geology*
Oil shale, oil gravity, trend-surface analysis: Smith, John W. 10856
*Geochemistry*
Eldora stock, contact, orthoclase, microcline, analyses: Wright, Thomas L. 00732
Eldora stock, orthoclase–microcline transition: Steiger, Rudolf H. 00731
*Maps, geologic*
Bristol Head quadrangle: Steven, Thomas A. 00834
Eldorado Springs quadrangle: Wells, John D. 00858
*Mineralogy*
Astrophyllite, El Paso County, crystal structure: Woodrow, P. J. 00823
Orthoclase, microcline, Eldora stock contact aureole: Wright, Thomas L. 00732
Tetradymite, Paonia area, X-ray data: Glatz, Alfred C. 00735
*Petrology*
San Juan Mountains, Creede caldera, volcanic sequence: Ratte, James C. 00767
*Stratigraphy*
Tertiary, Bristol Head quadrangle, section: Steven, Thomas A. 00834
*Volcanology*
San Juan Mountains, Miocene–Pliocene: Luedke, R. G. 10872

**Concretions**
*Composition*
Carbonate content, Quebec, northern Vermont: Warkentin, B. P. 00886

**Connecticut**
*Maps, geologic*
Columbia quadrangle: Snyder, George. 00812
Roxbury quadrangle, surficial: Malde, Harold E. 00652
*Stratigraphy*
Ordovician–Triassic, Columbia quadrangle, section: Snyder, George. 00812
*Structural geology*
Columbia quadrangle, recumbent fold system, mechanism: Snyder, George. 00812

**Conodonts**
*Cavusgnathus windsorensis n.sp.*
Mississippian, Canada, Atlantic Provinces, Windsor Group: Globensky, Yvon. 00770
*Gnathodus scotiaensis*
Mississippian, Canada, Atlantic Provinces, Windsor Group: Globensky, Yvon. 00770
*Hindeodella bretonensis n.sp.*
Mississippian, Canada, Atlantic Provinces, Windsor Group: Globensky, Yvon. 00770
*Mestognathodus dhuensis n.sp.*
Mississippian, Canada, Atlantic Provinces, Windsor Group: Globensky, Yvon. 00770
*Mississippian*
Nova Scotia, New Brunswick, Windsor Group, fauna: Globensky, Yvon. 00770
*Ordovician*
Ontario, Chaumont Formation, Ottawa Valley: Barnes, Christopher R. 00894

**Conodonts**
*Ozarkodina acadiensis n. sp.*
Mississippian, Canada, Atlantic Provinces, Windsor Group: Globensky, Yvon. 00770
**Construction materials**
*California*
Northeastern, resources: Gay, Thomas E., Jr. 10767
Sierra Nevada, resources: Clark, William B. 10772
*Montana*
Shale, expanded: Chelini, J. M. 10783
*Texas*
Cave Creek School quadrangle, resources: Barnes, Virgil E. 00917
Yeager Creek quadrangle, resources: Barnes, Virgil E. 00918
**Continental drift**
*Caribbean region*
Tertiary, island arc, evolution: Hamilton, Warren. 10816
*Newfoundland*
Correlation with British Isles: Kay, Marshall. 00658
Structural evidence, similarity to Ireland, Scotland: Kay, Marshall. 10854
*Rate*
Astronomical evidence, reliability: Markowitz, William. 10845
*Reconstruction*
Gondwana and Laurasia, originally equal size: Dietz, Robert S. 10733
**Continental margin**
*Alaska*
Alaskan Peninsula, Aleutian arc, Shumagin Shelf, evolution: Burk, C. A. 10800
*Arctic Ocean*
Alaska: Hunkins, Kenneth. 10818
*California*
Mineral resources: Wilson, Thomas A. 10736
Structure, acoustic reflection profiles: Curray, Joseph R. 10756
Structure, geophysical data: Rusnak, Gene A. 10755
*Canada*
Eastern, seismic, crustal study: Keen, M. J. 10742
Shelf, magnetic surveys: Hood, Peter. 10739
*Florida*
Eastern, relation to Bahama-Blake Plateau area: Ewing, J. I. 10822
*General*
Heat flow, regional patterns: Lee, W. H. K. 10808
Structure, transition to ocean basin: Worzel, J. Lamar. 10804
*Geophysical surveys*
Seismic, surface waves, phase velocity interpretation: Knopoff, Leon. 00914
*North America*
Atlantic Shelf magnetic anomaly: Geddes, Wilburt H. 10821
Eastern, structure, cf. Appalachian geosyncline: Drake, Charles L. 10820
**Continental margin**
*North America*
Northern, crust, structure: Roots, E. F. 10817
*Shelf*
California, Baja California, structure, deposits, seismic data: Moore, David Gillis. 10859
**Continental shelf**
*Atlantic Ocean*
Rhode Island, origin: Cotton, C. A. 10741
Virginia, origin: Cotton, C. A. 10741
*Pacific Ocean*
Mexico, origin: Cotton, C. A. 10741
**Continents**
*Distribution*
Drift from supercontinents: Dietz, Robert S. 10733
*Evolution*
Growth patterns: Wilson, J. Tuzo. 10807
*Structure*
Geophysical studies: Steinhart, John S. 10676
**Copper**
*Nevada*
Ely, Liberty pit, occurrence: Fournier, Robert O. 00653
Ely, Liberty pit, occurrence: Fournier, Robert O. 00793
*United States*
Reserves, 1964, distribution by region: Everett, F. D. 00872
**Core**
*Experimental studies*
Model studies, rigidity, viscosity: Sato, R. 00869
*Motions*
Surface, inferred from secular variation of magnetic field: Kahle, Anne B. 00876
*Physical properties*
Rigidity, viscosity: Sato, R. 00869
**Correlation**
*Methods*
Core logs, lithologic and electric: Smith, W. H. 00873
Indivisible aggregates, Devonian sequences, western Canada: Crickmay, C. H. 00861
Trace element and mineralogic variations, Esopus Formation, New York: Fenner, P. 00704
**Costa Rica**
*Engineering geology*
Dams, Cachi site, Reventazon River valley, exploration: Serafim, J. Laginha. 10773
*Volcanology*
Irazu Volcano, eruption, 1963–65: Murata, K. J. 10861
**Craters**
*Experimental studies*
Meteorite impact, rutile, shock-wave transformation: McQueen, Robert G. 00773
Nuclear, high-explosive events, growth, computer calculation: Cherry, J. T. 00803

**Cretaceous**
*California*
Northern, Upper, unconformity: Peterson, Gary L. 00679
Santa Ynez Mountains region, stratigraphy: Dibblee, T. W., Jr. 10813
*Dominican Republic*
Central, stratigraphy: Bowin, Carl O. 10791
*Montana*
Great Falls–Lewistown coal field, paleogeography: Silverman, Arnold J. 00853
*North America*
Cephalopoda, *Tetragonites*, taxonomy, evolution: Murphy, Michael A. 00877
*Oregon*
Southern, Upper, unconformity: Peterson, Gary L. 00679
*Texas*
North central, northern, west central, Lower, sands: Fisher, W. L. 00836
*Utah*
Escalante Upper Valley area, Straight Cliffs Sandstone coal sections: Doelling, Hellmut H. 00815
Wasatch Plateau, Reptilia, North Horn Formation, dinosaur eggs: Jensen, James A. 00646
*Virgin Islands*
Saint Croix, Mount Eagle Group: Whetten, John T. 10786
Saint Thomas and Saint John, stratigraphy: Donnelly, Thomas W. 10785
**Crust**
*Alaska*
Coastal area, seismic study 1955: Hales, A. L. 10699
*Arctic Ocean*
Relation to North American continental margin: Roots, E. F. 10817
*Atlantic Ocean*
Greenland basin, structure: Demenitskaya, R. M. 10796
Puerto Rico trench, structure: Bunce, Elizabeth T. 10799
Puerto Rico trench to Nares Deep, seismic studies, review: Hersey, J. B. 10798
*California*
Thickness, Sierra Nevada, Coast Ranges: Eaton, Jerry P. 10761
*Canada*
Eastern, continental margin, structure: Keen, M. J. 10742
Structure, eastern coast, seismic, gravity data: Dainty, A. M. 10687
*Caribbean Sea*
Structure, seismic studies: Hersey, J. B. 10798
*Composition*
Continental, estimate from seismic data: Pakiser, L. C. 10683
Continental, stable, model study: Ringwood, A. E. 10682
*Gulf Coastal Plain*
Structure, Mississippi embayment, western: McCamy, K. 10696
**Crust**
*Idaho*
Snake River Plain, structure, seismic profile: Hill, D. P. 10685
*Lake Superior region*
Physical properties, elasticity, 1963–64 experiments: Mansfield, R. H. 10670
Structure, seismic and gravity studies: Steinhart, John S. 10705
Structure, seismic study: Smith, T. Jefferson 10704
Structure, seismic study, time term interpretation: Berry, M. J. 10703
Structure, western basin: White, Walter S. 10706
Thickness, density: Weber, J. R. 10709
*Minnesota*
Structure, Midcontinent Gravity High, seismic study: Cohen, T. J. 10702
*Montana*
Structure, east–west seismic profiles: Asada, T. 10697
*Nevada*
Basin and Range province, structure, seismic profile: Hill, D. P. 10685
*North America*
Northern, continental margin: Roots, E. F. 10817
*Pacific Ocean*
Aleutian Trench, structure, model: Peter, George. 10815
Hawaiian ridge, trench, rise, relations to mantle: Woollard, G. P. 10801
*Puerto Rico*
Physical properties: Mattson, Peter H. 10819
*Structure*
Continents, geophysical studies: Steinhart, John S. 10676
Island arcs: Brock, B. B. 10805
Mountain areas, studies, history: Tuve, Merle A. 10698
Seismic studies, 1960–65, worldwide, review: James, David E. 10671
*Thickness*
Continental margins, trenches: Worzel, J. Lamar. 10804
*United States*
Washington, D. C., to San Francisco, magnetic survey: Zietz, Isidore. 10812
*Wisconsin*
Structure, Midcontinent Gravity High, seismic study: Cohen, T. J. 10702
**Crystal chemistry**
*Feldspar*
Volume of mixing, microcline–low albite and sanidine–high albite series: Orville, Philip M. 00711
**Crystal structure**
*Analysis*
Primary data, presentation in publications, recommendations: Kennard, O. 00669
*Astrophyllite*
Colorado, El Paso County: Woodrow, P. J. 00823

**Crystal structure**
*Cheralite*
Redetermination: Finney, J. J. 00738
*Heulandite*
Redetermination: Merkle, A. B. 00730
**Crystallography**
*Primary data*
Presentation in publications, recommendations: Kennard, O. 00669
*Twinning*
Growth, genesis, albite: Donnelly, Thomas W. 00710
**Deformation**
*Experimental studies*
Mechanism, fracture propagation, technique: Paulding, B. W., Jr. 10836
Mechanism, shear failure: Patton, F. D. 10825
Methods, triaxial testing, apparatus: Donath, F. A. 10827
Strength, calcite single crystals, torsion test: Borg, Iris. 00698
Strength, limestone, dolomite: Handin, John. 00699
Strength, plate load tests, in situ: Coates, D. F. 10840
Strength, plate load tests, in situ: Ladanyi, B. 10841
Strength, sandstone, glass, pH dependence: Street, Norman. 10829
Strength, tension and compression tests, schistose gneiss: Deklotz, E. J. 10823
*Field studies*
Elasticity, metamorphic rocks, Massachusetts: Murphy, Vincent J. 10921
Mechanism, Ontario, Ottawa Formation, folds: Norris, D. K. 00893
Methods, photoelastic coatings, strain measurement: Paulding, B. W., Jr. 10828
Methods, photoelastic coatings, strain measurement: Pincus, H. J. 10837
Strain analysis, California, Coast Ranges and San Andreas fault: Burford, Robert O. 10853
Strength, stress release in valley development: Ferguson, H. F. 00913
*Theoretical studies*
Creep, elasticity, mantle: Gordon, R. B. 10860
Creep, energy storage and dissipation properties: Kondner, Robert L. 10833
Elasticity, review: Walsh, J. B. 10929
Mechanism, radial expansion failure: Ladanyi, B. 10835
Moduli, tests, procedures: Clark, G. B. 10890
Moduli, tests, procedures: Deere, D. U. 10905
Plasticity, rock at low stress levels: Sage, Joseph D. 10824
Strength, polycrystalline rock, stress distribution under load: Mase, George E. 10923
Strength, polycrystalline rock, stress distribution under load: Shoua, Ezra D. 10922
**Deformation**
*Theoretical studies*
Strength, pore space structure effect: Walsh, J. B. 10826
Stress, calculation from drill hole deformation: Panek, L. A. 10904
Stress, measurement, anisotropy, time dependent deformation effects: Berry, D. S. 10907
**Devonian**
*Canada*
Correlation, western, method of indivisible aggregates: Crickmay, C. H. 00861
*Missouri*
Stromatoporoidea, description of species: Birkhead, Paul K. 00884
*Montana*
Western, Brachiopoda, Sappington Formation, zones: Gutschick, R. C. 00677
*Yukon*
Royal Creek, Lower, biostratigraphy: Lenz, A. C. 10913
**Diamonds**
*United States*
North central, occurrence in till, provenance: Gunn, Christopher B. 00626
**Differential thermal analysis**
*Data*
Clays, Missouri, lower Cabaniss Subgroup: Tennissen, Anthony C. 00808
*Methods*
Vermiculite, biotitic: Boss, B. D. 00724
**Dikes**
*Ontario*
Sudbury area, paleomagnetism: Larochelle, A. 00887
*Tourmaline–quartz*
Georgia, Decatur area, mineral zoning, structure: Centini, Barry A. 00744
**Dominican Republic**
*Areal geology*
Central: Bowin, Carl O. 10791
*Maps, geologic*
Central: Bowin, Carl O. 10791
*Stratigraphy*
Cretaceous–Tertiary, central: Bowin, Carl O. 10791
**Earth**
*Age*
Lead isotope, new value: Tilton, George R. 10851
*Elasticity*
Free oscillations, mode $_0T_2$ dissipation factor, core rigidity: Sato, R. 00869
*General*
Photographs, Gemini spacecraft: Lowman, Paul D., Jr. 10858
*Interior*
Discontinuities, seismic studies, review: James, David E. 10671
Geophysical studies: Steinhart, John S. 10676
High pressure experiments, insulator to metal transition: Samara, George A. 00671

**Earth**
*Interior*
Model, Gutenberg–Bullen A', theoretical seismograms, body waves: Landisman, Mark. 10701
Olivine–spinel melting relations, effect: Akimoto, Syun-Iti. 00675
*Surface morphology*
Relief features, major, genesis, energy-time factors: Wolfe, C. Wroe. 10730
*Temperature*
Thermal history, Recent observations: Lee, W. H. K. 10875
**Earth currents**
*Rapid variations*
Continental margins: Nagata, Takesi. 10809
**Earth tides**
*Variations*
Spatial, ocean tidal loading, geologic effects: Kuo, John T. 10681
**Earthquakes**
*Aftershocks*
Sequences, random nature, model study: Lomnitz, Cinna. 10686
*Alaska*
March 28, 1964, aftershocks, shear-type recovery: Chouhan, R. K. S. 10776
March 1964, atmospheric waves: Row, Ronald V. 00801
*California*
June 28, 1966, Parkfield, stress drop at source: Aki, Keiiti. 00802
June–August 1966, Parkfield–Cholame: Brown, Robert D., Jr. 00638
June–August 1966, Parkfield–Cholame, damage: Yerkes, R. F. 00641
June–August 1966, Parkfield–Cholame, fractures: Brown, Robert D., Jr. 00639
June–August 1966, Parkfield–Cholame, progressive deformation: Wallace, Robert E. 00629
June–August 1966, Parkfield–Cholame, seismic studies: Eaton, Jerry P. 00640
June–August 1966, Parkfield–Cholame, water resources effects: Waananen, A. O. 00642
*Effects*
Control of layering in intrusives: Hoffer, A. 10865
Engineering structures, world problem: Hodgson, John H. 10775
Free oscillations, prolongation by aftershocks: Press, Frank. 10691
*Elastic waves*
Attenuation, mantle, cause: Gordon, R. B. 10860
Q factor, overestimation: Press, Frank. 10691
*Energy*
Amplitude spectrum scaling law: Aki, Keiiti. 00802
*General*
Seismicity, history, interpretation of layered intrusive: Hoffer, A. 10865
**Earthquakes**
*Washington*
April 29, 1965, Puget Sound, magnetic survey, epicentral area: Kaarsberg, Ernest A. 00775
**Echinodermata**
*Helicoplacoidea*
Cambrian, taxonomy, morphology: Durham, J. Wyatt. 00771
*Polyplacida, n. subclass*
Cambrian, Helicoplacoidea: Durham, J. Wyatt. 00771
*Polyplacus kilmeri, n.gen., n.sp.*
Cambrian, Lower, California, east-central, helicoplacoids: Durham, J. Wyatt. 00771
*Waucobella nelsoni, n.gen., n.sp.*
Cambrian, Lower, California, east-central, helicoplacoids: Durham, J. Wyatt. 00771
**Ecology**
*California*
Intertidal, Tomales Bay, beach sands, salinity, pore water: Johnson, Ralph Gordon. 00819
*Mexico*
Marine, Veracruz, Isla de Lobos reef complex: Rigby, J. Keith. 00647
*New York*
Terrestrial, economic and physical geography: Thompson, John H. 10848
*Stromatolites*
Marine, structure, distribution, algal mats, Bahamas: Monty, Claude L. V. 00789
**Economic geology**
*Practice*
Society of Economic Geologists: Gustafson, J. K. 00794
*Textbooks*
Mineral resources, relation to geology, engineering, mining, politics, law: Flawn, Peter T. 10774
**Education**
*Remote sensing*
Needs: Schultz, Charles H. 10879
**Elastic properties**
*Forsterite*
Pressure derivatives of sound velocities, synthetic: Schreiber, Edward. 00672
*Mantle material*
Creep and seismic attenuation, depth dependence: Gordon, R. B. 10860
*Metamorphic rocks*
Moduli, Massachusetts, Mt. Holyoke Range: Murphy, Vincent J. 10921
*Rocks, jointed*
Application of theoretical studies: Walsh, J. B. 10929
*Tektites*
Resonant sphere measurement technique: Soga, Naohiro. 00784
**Electrical methods**
*Electromagnetic*
INPUT airborne system, new developments: Boniwell, J. B. 00931

**Electrical methods**
*Experimental studies*
Pore structure, relation to conductivity: Fatt, Irving. 00721
*Techniques*
Limestone terrain, cavity location: Love, Colin L. 00912
**Electrical surveys**
*Quebec*
Lake Chibougamau, induced polarization: Hallof, P. G. 00930
**Elements**
*Geochemistry*
Marine sediments, distribution in carbonate fraction: Wangersky, Peter J. 00632
**Engineering geology**
*Aqueducts*
California, San Andreas fault crossings: Arnold, A. B. 00923
*Earthquakes*
Resistant construction, world problem: Hodgson, John H. 10775
*Foundations*
Exploration methods, Cachi dam site, Costa Rica: Serafim, J. Laginha. 10773
Permeability, three hole pressure test: Snow, David T. 10928
*Highways*
Wyoming, failure, relation to underlying soils: Duguid, James O. 00665
*Land subsidence*
California, Great Valley: Poland, J. F. 10734
California, San Jacinto Valley, bordering fault motions: Fett, John D. 00929
Solution cavity location, geophysical methods: Love, Colin L. 00912
*Materials, properties*
Inelastic properties, determination, laboratory loading system: Hoskins, J. R. 10898
New Jersey, Brunswick Shale, road foundation: Jumikis, Alfreds R. 10830
Rock fabric, optical data processing: Pincus, Howard J. 10831
Schistose gneiss, anisotropy, strength, tests: Deklotz, E. J. 10823
Testing techniques, foundation rocks: Barry, A. J. 10899
*Permafrost*
Ontario, Ottawa, sporadic, effect of surface temperature: Gold, L. W. 00896
*Petroleum*
Reservoir mechanics, fluid migration and accumulation, textbook: Levorsen, A. I. 00791
*Rock mechanics*
Creep, energy storage and dissipation properties: Kondner, Robert L. 10833
Deformation, moduli, tests, procedures: Clark, G. B. 10890
Deformation, moduli, tests, procedures: Deere, D. U. 10905
Failure, radial expansion, mechanism: Ladanyi, B. 10835

**Engineering geology**
*Rock mechanics*
Failure, responsible mesoscopic structures, coal mines: Norris, D. K. 10832
Fracture mechanics, compression tests: Paulding, B. W., Jr. 10836
Inelastic properties, determination, laboratory loading system: Hoskins, J. R. 10898
Inelastic properties, determination, laboratory loading system: Paulding, B. W., Jr. 10897
Limestone and dolomite, failure, intermediate principal stress effect: Handin, John. 00699
Microstructure, relation to physical properties: McWilliams, J. R. 10906
Plasticity, low stress levels, theoretical studies: Sage, Joseph D. 10824
Polycrystalline rock, stress distribution under load: Mase, George E. 10923
Polycrystalline rock, stress distribution under load: Shoua, Ezra D. 10922
Pore pressure measurement, equipment and procedures: Neff, T. L. 10838
Pore pressure measurement, equipment and procedures: Paulding, B. W., Jr. 10839
Relation to pore space structure: Walsh, J. B. 10826
Salt mines, room and pillar mining, stress redistribution: McClain, W. C. 00806
Sandstone and glass, strength, pH dependence: Street, Norman. 10829
Shear failure, experimental studies: Maurer, William C. 10834
Shear strength, experimental studies: Patton, F. D. 10825
Shear strength, weak shales, laboratory tests: Herrmann, H. G. 10918
Shock waves, magnetite rock, surface explosion: Sassa, K. 00805
Strain, study by photoelastic coatings: Paulding, B. W., Jr. 10828
Strain, study by photoelastic coatings: Pincus, H. J. 10837
Strength, plate load tests, in situ: Coates, D. F. 10840
Strength, plate load tests, in situ: Ladanyi, B. 10841
Strength, tests, laboratory techniques: Hendron, A. J., Jr. 10896
Stress, calculation from drill hole deformation: Panek, L. A. 10904
Stress determination, borehole deformation gage: Crouch, S. L. 00804
Stress, measurement, anisotropy, time dependent deformation effects: Berry, D. S. 10907
Testing techniques, foundation rocks: Barry, A. J. 10899
Testing techniques, symposium: Am. Society for Testing and Materials. 10924
Triaxial testing, apparatus: Donath, F. A. 10827

**Engineering geology**
*Salt-water intrusion*
Oklahoma-Texas, Arkansas-Red River basins: U.S. Army Corps of Engineers. 10673
*Shorelines*
Atlantic Coast, transport, wave-energy correlation: Fairchild, John C. 10857
Sediment transport, budget of littoral processes, California: Bowen, A. J. 10777
*Slope stability*
Weak shales: Herrmann, H. G. 10918
*Soils*
West Indies, classification, geomorphic units: Beaven, P. J. 10917
*Submarine installations*
Ocean surface and undersea environments, problems: Craven, John P. 00785

**Epeirogenesis**
*Paleozoic*
Newfoundland: Kay, Marshall. 00658

**Erosion**
*Atlantic Ocean*
Blake Plateau: Ewing, J. I. 10822
*Beaches*
Atlantic Coast, transport, correlation with wave energy: Fairchild, John C. 10857

**Estuaries**
*Sedimentation*
Gulf of Saint Lawrence, Laurentian channel: Conolly, J. R. 00631

**Evaporites**
*Nova Scotia*
Pugwash, Mississippian, structure: Evans, Robert. 00796

**Evolution**
*Cephalopoda*
*Tetragonites*, Cretaceous: Murphy, Michael A. 00877
*Foraminifera*
*Pulleniatina*: Banner, F. T. 00840

**Explosion phenomena**
*Experimental studies*
Crater growth, computer calculation technique: Cherry, J. T. 00803
Shock waves, surface event, magnetite rock: Sassa, K. 00805

**Faults**
*Mechanism*
Compression faults in valley bottoms, Pennsylvania, Allegheny Plateau: Ferguson, H. F. 00913
*Movement*
California, Casa Loma, San Jacinto faults, evidence: Fett, John D. 00929
*Normal*
Arizona, Mammoth quadrangle, Mogul fault: Creasey, S. C. 00859
Lake Superior region, Keweenaw area: Bacon, L. O. 10711
*Overthrust*
Lake Superior region, Keweenaw fault: Bacon, L. O. 10711

**Faults**
*Patterns*
California, Santa Ynez Mts., central: Dibblee, T. W., Jr. 10813
*Strike-slip*
California, Cholame Valley, San Andreas, creep 1966: Wallace, Robert E. 00629
California, Cholame Valley, San Andreas slippage, June 1966: Eaton, Jerry P. 00640
California, Contra Costa County, Calaveras fault zone: Saul, Richard B. 00697
California, northern, San Andreas: Bailey, Edgar H. 10763
California, San Andreas, cumulative offset: Dibblee, T. W., Jr. 10758
California, San Andreas, displacements: Crowell, John C. 10842
California, San Andreas, recent movement: Meade, Buford K. 10759
California, San Andreas, recent movements: Meade, Buford K. 10878
California, San Andreas system: Brabb, Earl E. 10744
California, San Andreas system: Oakeshott, Gordon B. 10757
Newfoundland, continental drift evidence: Kay, Marshall. 10854
United States, eastern, continental margin: Drake, Charles L. 10820
*Systems*
Dominican Republic, central: Bowin, Carl O. 10791

**Florida**
*Absolute age*
Peat, southern, submergence rate: Scholl, David W. 00682
*Engineering geology*
Shorelines, Big Bend area, beach retrogression: Warnke, Detlef A. 00668
*Geomorphology*
Big Bend area, beach retrogression, hurricane effects: Warnke, Detlef A. 00668
*Hydrogeology*
Escambia, Santa Rosa Counties, ground-water resources: Barraclough, Jack T. 00817
Immokalee area, ground-water resources: McCoy, Henry J. 00854
*Maps, ground water*
Escambia, Santa Rosa Counties: Barraclough, Jack T. 00817
*Paleontology*
Vertebrata, Pliocene, low sea-level evidence: Webb, S. David. 00703

**Fluid inclusions**
*Volcanics*
Effect on K-Ar ages: Funkhouser, J. G. 10863

**Fluorine**
*Geochemistry*
Loss, silicic volcanic rocks, crystallized or glassy: Noble, Donald C. 00705

**Fluorspar**
*Kentucky*
Fredonia quadrangle, resources: Rogers, William B. 00830

**Folds**
*Flexural-slip*
Mechanism, Ontario, Ottawa area, Queensway pair: Norris, D. K. 00893
*Geometry*
Nova Scotia, salt: Evans, Robert. 00796
Virgin Islands, Saint Croix: Whetten, John T. 10786
*Mechanism*
Ontario, Ottawa area, Queensway flexural-slip: Norris, D. K. 00893
*Patterns*
California, Santa Ynez Mts., central: Dibblee, T. W., Jr. 10813
*Recumbent*
Connecticut, Columbia quadrangle, mechanism: Snyder, George. 00812
*Synclinal*
Lake Superior region, evolution: Halls, H. C. 10689
**Foraminifera**
*General*
Assemblages, alteration by ocean-water solution: Berger, Wolfgang H. 00701
*Globorotalia pachyderma*
Morphology, distribution: Jenkins, D. Graham. 00855
*Pulleniatina*
Taxonomic review, origin, evolution: Banner, F. T. 00840
*Tertiary*
California, Kern County, San Emigdio Formation: DeLise, K. C. 00779
Panama, Burica Formation, Miocene, new species: Seiglie, George A. 10877
*Tosaia weaveri n.sp.*
Miocene, Panama, Burica Formation: Seiglie, George A. 10877
**Fossils, problematic**
*Precambrian*
Ontario, Elliot Lake area, Huronian Series, upper: Hofmann, H. J. 00752
**Fractures**
*Experimental studies*
Crack propagation, technique: Paulding, B. W., Jr. 10836
*Patterns*
Pennsylvania, Allegheny Plateau, valley stress release: Ferguson, H. F. 00913
*Tectonic*
California, Parkfield-Cholame earthquakes: Brown, Robert D., Jr. 00639
**Fungi**
*Ordovicimyces gallowayi, n.gen.n.sp.*
Ordovician, Illinois, in ectoproct bryozoan: Elias, Maxim K. 10723
*Propythium carbonarium, n.gen.n.sp.*
Pennsylvanian, Nebraska, in ectoproct bryozoan: Elias, Maxim K. 10723
*Saprolegniales*
Taxonomy, fossil and living forms: Elias, Maxim K. 10723
**Gallium**
*Abundance*
Iron meteorites: Wasson, John T. 00787
**Gas, natural**
*Alaska*
Iniskin-Tuxedni region, exploration: Detterman, Robert L. 00648
*California*
Great Valley, resources: Hart, Earl W. 10749
*Kentucky*
West Liberty quadrangle, resources: Englund, Kenneth J. 00650
*Oklahoma*
North Gotebo area, occurrence: Takken, Suzanne. 00713
*West Virginia*
West central, Newburg sand, production: Patchen, Douglas G. 00843
**Gastropoda**
*Bellerophontina*
Pennsylvanian, shell structure: MacClintock, Copeland. 00778
*Bellerophontoidea*
Morphology, shell structure, post-Ordovician and Recent: MacClintock, Copeland. 00778
*Patelloidea*
Morphology, shell structure, post-Ordovician and Recent: MacClintock, Copeland. 00778
**General**
*Philosophy*
Huxley, Thomas Henry, *On a piece of chalk*: Huxley, Thomas Henry. 00871
*Textbooks*
Petroleum geology: Levorsen, A. I. 00791
Physiography of the United States and Puerto Rico: Hunt, Charles B. 00790
**Geochemical prospecting**
*Data processing*
Electronic, coding system, data cards: Gleeson, C. F. 00927
*Soils*
Trace elements, A horizon: Boyle, R. W. 00797
**Geochemical surveys**
*Lake Superior region*
Lake sediment and water, Sr, Pb isotopes: Hart, Stanley R. 10674
**Geochemistry**
*Abundance of elements*
Basalts, Arizona-Utah, Th, U, and K variances: Best, Myron G. 00654
*Chemical fractionation*
Granite batholith, relation to U and Th distribution: Ragland, Paul C. 00706
*Clay minerals*
Smectites and vermiculites, organic complexes, cation exchange: Brindley, G. W. 10927
*Cycles*
Carbonate, recent oceans: Pytkowicz, Ricardo M. 00660
*Exchange capacity*
Clay minerals, organic complexes: Brindley, G. W. 10927
*Methods*
P-T diagrams, construction: Zen, E-an. 00857
Sulfide detection in minerals, spot tests: Chan, Frank L. 00788

**Geochemistry**
*Sea water*
Salts, partial equivalent volumes: Duedall, Iver W. 00814
*Sediments*
Pore water, lake and river sediment, silica and chloride: Harriss, Robert C. 00818
*Solubility*
Quartz, metallic sulfides, hydrothermal solutions: Dickson, F. W. 10876
Silica, hot springs: Fournier, R. O. 10870
**Geologic barometry**
*Metamorphic facies*
$Al_2SiO_5$ polymorphs, use: Hietanen, Anna. 00634
**Geologic exploration**
*Methods*
Remote sensing, vapor detection: Barringer, A. R. 10880
**Geologic thermometry**
*Methods*
Biotite composition: Fournier, Robert O. 00653
*Pegmatites*
New York, Adirondack districts and Bedford area: Tan, Li Ping. 10779
*Potassic feldspar*
Colorado, Eldora area: Steiger, Rudolf H. 00731
**Geological exploration**
*Instruments*
Remote sensors, selection, applications: Fischer, William A. 10892
*Methods*
Georgia, gabbro norite bodies, Iredell loam as guide: Matthews, Vincent. 00746
Infrared, rock, soil compositions: Lyon, R. J. P. 10886
Radar, arctic terrain: Leighty, R. D. 10894
Radar, local areas: Rydstrom, Hubert O. 10902
Remote sensing, airborne, computer data reduction: Barringer, A. R. 10887
Remote sensing, multispectral, applications, limitations: Colwell, Robert L. 10900
**Geomorphology**
*Environment*
Coastal plaine, low energy beaches, hurricane effects, Florida: Warnke, Detlef A. 00668
*Fluvial features*
Drainage pattern, New York, Tug Hill Plateau, Salmon River: Graham, R. S. 00865
Terraces, stream capture, Montana, Beartooth Mts.: Ritter, Dale F. 00692
Transport, California, Cache Creek basin: Lustig, Lawrence K. 00906
*Glacial features*
Moraines, multiple advances, Alberta, Banff area: Rutter, N. W. 10912
Moraines, Yukon, Saint Elias Mts., chronology: Denton, George H. 00691
**Geomorphology**
*Landform description*
Interpretation, side looking radar imagery: McAnerney, J. M. 10883
Mexico, Chiapas, physiographic divisions, karst development: Gerstenhauer, Armin. 10724
New York, physiographic regions, special features: Cressey, George B. 10844
*Landform evolution*
Lithosphere surface, major features, energy source: Wolfe, C. Wroe. 10730
New York, Tug Hill Plateau, drainage changes: Graham, R. S. 00865
*Quantitative geomorphology*
Channel networks: Shreve, Ronald L. 00633
*Shore features*
Beaches, Florida, Big Bend area, retrogression: Warnke, Detlef A. 00668
*Solution features*
Karst development, tropical climate: Monroe, Watson H. 10781
Karst, Mexico, Chiapas, genesis: Gerstenhauer, Armin. 10724
*Textbooks*
Physiography of the United States and Puerto Rico: Hunt, Charles B. 00790
*Transport*
Littoral, correlation with wave energy: Fairchild, John C. 10857
Littoral, processes, budget concept: Bowen, A. J. 10777
**Geophysical surveys**
*California*
Northern, compilation of recent data: Bailey, Edgar H. 10763
**Geophysics**
*Practice*
Role in expanding man's domain: Kendall, Robert C. 00878
Role in expanding man's domain: Press, Frank. 00874
**Georgia**
*Mineralogy*
Altamaha River flood plain, coastal area, alluvium: Jinks, D. D. 00745
Hornblende, Pleistocene Holocene, coastal plain sediments: Carver, Robert E. 00862
Tourmaline quartz dike, Decatur area, mineral zoning: Centini, Barry A. 00744
*Paleontology*
Fauna, Tertiary, Eocene, Screven County, silicified reef: Bond, T. A. 00742
Mollusca, Cambrian, Conasauga shale, Floyd County, hyolithid fauna: Englebright, Steven C. 00864
*Petrology*
Jasper County, gabbro norite bodies, Iredell loam as marker: Matthews, Vincent. 00746
Tourmaline quartz dike, Decatur area, mineral zoning: Centini, Barry A. 00744
*Sedimentary petrology*
Altamaha River flood plain, coastal area, alluvium: Jinks, D. D. 00745

**Georgia**
*Stratigraphy*
Cambrian, Conasauga Group, Bartow County: Smith, James W. 00863
Cenozoic, east central, coastal plain sediments: Carver, Robert E. 00862
Tertiary, Ashburn formation, coastal plain, new name for Hawthorn Formation: Olson, Norman K. 00741

**Geosynclines**
*Chesteran–Atokan*
Sedimentation, Arkansas, Ouachita Mts.: Walthall, Bennie H. 00676
*Rocky Mountains*
Evolution, palinspastic reconstruction, Alberta–British Columbia: Bally, A. W. 10716

**Germanium**
*Abundance*
Iron meteorites: Wasson, John T. 00787

**Glaciers**
*Greenland*
Inland ice sheet, mass budget, negative: Bauer, Albert. 10843
*Ice*
Mass balance, Greenland ice sheet, negative budget: Bauer, Albert. 10843
Thickness, Greenland, radar survey: Rinker, J. N. 10881
*Washington*
South Cascade Glacier, multispectral sensing tests: Meier, Mark F. 10901

**Gold**
*Abundance*
Marysville stock, Montana, minerals, variation: Mantei, Erwin J. 00694
*California*
Klamath Mountains, occurrence: Albers, John P. 10766
*Ontario*
Birch–Uchi Lakes area, occurrence, genesis: Goodwin, A. M. 00883
*South Dakota*
Homestake mine, distribution, sampling, statistical analysis: Koch, George S., Jr. 00751
*United States*
Reserves in base metal ores: Everett, F. D. 00872

**Graptolithina**
*Ordovician*
British Columbia, Glenogle area, zones: Larson, M. L. 10916
*Ordovician–Silurian*
Canada, Cordillera–Arctic Archipelago assemblage: Jackson, D. E. 10909
*Silurian–Devonian*
Yukon, faunal units: Lenz, A. C. 10913

**Gravel**
*Tennessee*
Aspen Hill quadrangle, resources: McCary, Charles E. L. 00825

**Gravity methods**
*Instruments*
Gravimeter, sea bottom: Wing, Charles G. 00879
*Interpretation*
Anomalies, ocean ridges, trenches: Bowin, Carl. 10810

**Gravity surveys**
*California*
Northern, summary: Chapman, Rodger H. 10735
*Canada*
Eastern coast, crust and mantle studies: Dainty, A. M. 10687
Precambrian shield, relation to crustal uplift: Innes, M. J. S. 10852
*Caribbean region*
Anomaly belts: Talwani, Manik. 10728
Island arc anomalies, Princeton Univ. project: Hess, H. H. 10790
*Lake Superior region*
Crustal studies, 1963 experiment: Steinhart, John S. 10705
Isle Royale–Keweenaw Peninsula, interpretation: White, Walter S. 10706
Keweenaw area, structure: Bacon, L. O. 10711
Underwater, cf. seismic: Weber, J. R. 10709
Western basin: Wold, Richard J. 10710
*Pacific Ocean*
Aleutian Trench, anomalies: Peter, George. 10815
Crustal studies, Hawaiian Islands arc: Woollard, G. P. 10801
Mendocino escarpment, eastern, interpretation: Dehlinger, Peter. 00868
*United States*
Isostatic anomalies, regional relations: Woollard, G. P. 10680

**Greenland**
*Geophysical surveys*
Ice cap, thickness, bedrock profile, radar: Rinker, J. N. 10881
Ice sheet, seismic: Brockamp, B. 10930
Northwestern, radar imagery: Leighty, R. D. 10894
*Glacial geology*
Inland ice sheet, mass budget, negative: Bauer, Albert. 10843
*Petrology*
Eqaluit peninsula, Julianehab granite: Scharbert, Heinz G. 10712

**Ground water**
*Arkansas*
Resources, Pulaski, Saline Counties: Plebuch, Raymond O. 00932
*California*
Levels, Parkfield–Cholame area, 1966 earthquake effects: Waananen, A. O. 00642
Resources, Great Valley: Poland, J. F. 10734
*Florida*
Resources, Escambia, Santa Rosa Counties: Barraclough, Jack T. 00817

**Ground water**
*Florida*
Resources, Immokalee area: McCoy, Henry J. 00854
*New England*
Resources, Connecticut River basin: Cederstrom, D. J. 00905
*Ohio*
Resources, Portage County: Winslow, John D. 10847
*Ontario*
Recharge, southern, effects of soil textures: Ayers, H. D. 00892
*Oregon*
Resources, quality, Baker Valley: Lystrom, D. J. 00822
*Texas*
Resources, Yeager Creek quadrangle: Barnes, Virgil E. 00918
*United States*
Movement, southeastern, Tertiary limestones, changes with time: LeGrand, H. E. 10850
Recharge, Arkansas–Red River basins, pollution: U.S. Dept.Health, Educ., Welfare. 10669
Recharge, Southern High Plains, Ogallala Formation, artificial: Hauser, V. L. 00718

**Gulf Coastal Plain**
*Geophysical surveys*
Mississippi embayment, western, seismic, crustal study: McCamy, K. 10696
*Stratigraphy*
Miocene, Florida–Texas, depositional history, foraminiferal correlation: Rainwater, E. H. 10715

**Gulf of Saint Lawrence**
*Sedimentary petrology*
Laurentian channel, sediments: Conolly, J. R. 00631

**Gypsum**
*Experimental studies*
Equilibrium with anhydrite, effect of $H_2O$ activity: Hardie, Lawrence A. 00736
*Geochemistry*
Dehydration temperature, thermochemical calculations: Hardie, Lawrence A. 00736

**Hawaii**
*Absolute age*
Oahu, Ewa Coastal Plain, basalt, K–Ar: Stearns, Harold. 10732
*Geochemistry*
Basalt, uranium isotopes, disequilibrium, analyses: Somayajulu, B. L. K. 10795
Salt Lake Crater, garnet pyroxenite inclusions: Green, D. H. 10787
*Geomorphology*
Physiographic regions, textbook: Hunt, Charles B. 00790
*Geophysical surveys*
Crustal studies, seismic, gravity: Woollard, G. P. 10801
Hawaiian Ridge, magnetic, volcanological implications: Malahoff, A. 10864

**Hawaii**
*Geophysical surveys*
Puna submarine ridge, magnetic: Malahoff, Alexander. 00627
*Maps, geomorphologic*
Land-surface form: Hammond, Edwin H. 10926
*Marine geology*
Puna ridge, structure: Malahoff, Alexander. 00627
*Petrology*
Salt Lake Crater, garnet pyroxenite inclusions: Green, D. H. 10787
*Stratigraphy*
Oahu, Ewa Coastal Plain, cores, unconformities: Stearns, Harold. 10732
*Structural geology*
Northeastern, continental margin, evolution: Worzel, J. Lamar. 10804
*Volcanology*
Kilauea, deformation measurements: Decker, R. W. 10866
Kilauea, rift zones, gravity slide origin: Moore, J. G. 10871

**Heat flow**
*Measurement*
Oceans, shallow water: Lee, W. H. K. 10808
*Regional patterns*
Continental margins, island arcs: Lee, W. H. K. 10808
Implications: Lee, W. H. K. 10875

**Heavy minerals**
*Ocean floor*
Placer and nodular deposits: MacDonald, Gordon J. F. 00774

**History**
*Mineral resources*
Resources development: Flawn, Peter T. 10774

**Hydrogen**
*Isotopes*
Tritium, cosmogenic, in iron meteorites: Fisher, David E. 00881

**Hydrogeology**
*Aquifer properties*
Laboratory tests, Arkansas, Grand Prairie area: Johnson, A. I. 10713
*Ground-water contamination*
United States, Arkansas–Red River basins: U.S. Dept.Health, Educ., Welfare. 10669
*Resource evaluation*
Remote sensors, airborne, possibilities: Barringer, A. R. 10887
*Salt-water intrusion*
California, Alamitos Gap, water barrier construction: Johnson, Michael. 00882
Oklahoma–Texas, Arkansas–Red River basins: U.S. Army Corps of Engineers. 10673
United States, Arkansas–Red River basins: U.S. Dept.Health, Educ., Welfare. 10669

**Hydrothermal alteration**
*Argillic*
Porphyry copper, Nevada: Fournier, Robert O. 00793
*Montana*
Rainy Creek biotite pyroxenite, Libby area, products: Boettcher, A. L. 10908
**Ice ages, ancient**
*Paleozoic, late*
Worldwide evidence, review: Wanless, Harold R. 10722
**Idaho**
*Geophysical surveys*
Snake River Plain, seismic, crustal studies: Hill, D. P. 10685
**Igneous rocks**
*Basalt*
Composition, Arizona–Utah, variations: Best, Myron G. 00654
Crystallization, alkali type, silicate systems: Schairer, J. F. 10862
Eruptive history, Mexico, Socorro Island: Bryan, W. B. 10874
Geochemistry, uranium isotope disequilibrium: Somayajulu, B. L. K. 10795
Petrology, olivine–melilite, crystallization: Onuma, Kosuke. 00726
*Classification*
Pyroclastic vs. epiclastic: Fisher, Richard V. 10721
*Composition*
Oxygen isotope, fractionation: Garlick, G. Donald. 10792
*Dacite*
Petrology, Wyoming, Stinkingwater mining region: Fisher, Frederick S. 00662
*Differentiation*
Greenland, Eqaluit peninsula, Julianehab granite: Scharbert, Heinz G. 10712
*General*
Composition, Virgin Islands, Saint Croix: Whetten, John T. 10786
*Granitic*
General description, California, Coast Ranges, Salinian block: Compton, Robert R. 10751
Petrology, strontium isotope data: Moorbath, S. 00795
*Granodiorite*
Petrology, Wyoming, Stinkingwater mining region: Fisher, Frederick S. 00662
*Ignimbrite*
Petrology, Central America: McBirney, A. R. 10873
*Keratophyre*
General description, Dominican Republic, central: Bowin, Carl O. 10791
*Kimberlite*
General description, Kansas, Riley County pipes: Brookins, Douglas G. 00816
*Obsidian*
Alteration, hydration, Nevada: Noble, Donald C. 00709
**Igneous rocks**
*Pegmatite*
Differentiation, New York: Tan, Li-Ping. 10779
Mineralogy, orthoclase–microcline transition, Colorado, Eldora area: Steiger, Rudolf H. 00731
*Physical properties*
Reflectance, ultraviolet, lunar application: Greenman, Norman N. 00783
*Porphyry*
Alteration, Nevada: Fournier, Robert O. 00653
*Pyroxenite*
Petrology, geochemistry, Hawaii, Salt Lake Crater: Green, D. H. 10787
*Rhyolite*
Eruptive history, Mexico, Socorro Island: Bryan, W. B. 10874
Petrology, Central America: McBirney, A. R. 10873
*Ultramafic*
Petrology, Montana: McDonald, J. A. 00799
*Volcanic ash*
Petrology, New Mexico, Bandelier Tuff, eruptive conditions: Smith, R. L. 10869
Tephrachronology, Pacific Ocean, northern: Ninkovich, Dragoslav. 10789
*Volcanics*
Absolute age, anomalous K–Ar, fluid inclusions as source: Funkhouser, J. G. 10863
Alteration, silicic glass, hydration process, Nevada: Noble, Donald C. 00709
Eruptive history, San Juan Mts., Colorado, Miocene–Pliocene: Luedke, R. G. 10872
General description, California, Cascade Range and Modoc Plateau: Macdonald, Gordon A. 10737
General description, Colorado, Creede caldera: Ratte, James C. 00767
General description, Dominican Republic, central: Bowin, Carl O. 10791
General description, Wyoming, Stinkingwater mining region: Fisher, Frederick S. 00662
Genesis, Puerto Rico: Mattson, Peter H. 10819
Geochemistry, silicics, halogen loss: Noble, Donald C. 00705
Petrology, Ontario, Birch–Uchi Lakes area: Goodwin, A. M. 00883
Petrology, Virgin Islands, St. Thomas, St. John: Donnelly, Thomas W. 10785
Stratigraphy, California, Sierra Nevada, central: Slemmons, David B. 10771
**Illinois**
*Paleontology*
Algae, fungi, in bryozoan, Ordovician, Middle: Elias, Maxim K. 10723
*Stratigraphy*
Pennsylvanian, Upper, correlation with Kentucky: Smith, W. H. 00873

**Inclusions**
*Kimberlite*
Kansas, Riley County pipes: Brookins, Douglas G. 00816
*Quartz diorite stock*
Arizona, Santa Catalina Mts., Leatherwood intrusion: Hanson, H. S. 00743
*Silicate*
Chromite host: McDonald, J. A. 00799
**Industrial minerals**
*California*
Northeastern, resources: Gay, Thomas E., Jr. 10767
Sierra Nevada, resources: Clark, William B. 10772
**Infrared methods**
*Techniques*
Rock, soil compositions, spectral signatures, cf. computer data: Lyon, R. J. P. 10886
**Infrared surveys**
*Washington*
South Cascade Glacier, evaluation: Meier, Mark F. 10901
*Wyoming*
Yellowstone National Park, hot earth location: Miller, Lee D. 10884
**Intrusions**
*Layered*
Petrology, chromite: McDonald, J. A. 00799
*Pipes*
Kansas, Riley County, kimberlites, injection temperature: Brookins, Douglas G. 00816
*Structure*
Greenland, Eqaluit peninsula, Julianehab granite: Scharbert, Heinz G. 10712
Layered, earth tremor control: Hoffer, A. 10865
Virgin Islands, Saint Croix: Whetten, John T. 10786
**Invertebrata**
*California*
Pleistocene, Cayucan cf. Verdean faunal provinces, age: Veeh, H. Herbert. 00688
**Iron**
*Analysis*
Mossbauer absorption spectrography, clay minerals: Weaver, Charles E. 00685
*Lake Superior region*
Taconite, description, beneficiation: Heising, L. F. 00750
*Michigan*
Marquette Range, hard hematite, genesis: Symons, D. T. A. 00768
*Ontario*
Steep Rock Range, hard goethite, genesis: Symons, D. T. A. 00768
**Island arcs**
*Structure*
Crustal blocks, configuration: Brock, B. B. 10805
**Isostasy**
*M discontinuity*
Adjustment, calculation as function of time: vandeLindt, W. J. 00749
**Isostasy**
*Ocean basins*
Ridges, trenches, gravity anomalies: Bowin, Carl. 10810
*United States*
Regional relations, gravity and seismic studies: Woollard, G. P. 10680
**Isotopes**
*Argon*
Retentivity of Ar-40 in feldspars: Livingston, Donald E. 00680
*Hydrogen*
Iron meteorites, cosmogenic tritium loss: Fisher, David E. 00881
*Krypton*
Achondrite meteorites, anomalies: Bogard, D. D. 00684
*Lead*
Analysis, triple filament method: Catanzaro, E. J. 00880
Feldspar, granitic rocks, North America: Tilton, George R. 10851
Galena, ratios, stratiform cf. vein ore deposits: Ostic, R. G. 00888
Sediments, water, Lake Superior: Hart, Stanley R. 10674
Zircon, hydrothermal stability: Pidgeon, R. T. 10725
*Oxygen*
Caribbean cores, variations, power spectrum density analysis: Kemp, Warren C. 00670
Coexisting minerals, regionally metamorphosed rocks: Garlick, G. Donald. 00702
Igneous rocks, fractionation: Garlick, G. Donald. 10792
*Sediments*
Variation, Caribbean cores, power spectrum density analysis: Kemp, Warren C. 00670
*Strontium*
Ratios, mineralized intrusives: Moorbath, S. 00795
Sediments, water, Lake Superior: Hart, Stanley R. 10674
Water, analysis method, Sr 90: Johnson, J. O. 00933
*Tellurium*
Chondrites, excess Te 128: Kuroda, P. K. 00681
*Uranium*
Basalt, disequilibrium: Somayajulu, B. L. K. 10795
Zircon, hydrothermal stability: Pidgeon, R. T. 10725
*Xenon*
Chondrites, excess Xe 129: Kuroda, P. K. 00681
**Jamaica**
*Sedimentary petrology*
Lloyds District, White Limestone Group, slump structure: Robinson, E. 00657
*Stratigraphy*
Eocene, White Limestone Group, Lloyds Member: Robinson, E. 00657

**Jurassic**
*Alaska*
Iniskin Tuxedni region: Detterman, Robert L. 00648
Northern, east central, Pelecypoda, monotids: Imlay, Ralph W. 00644
*California*
East central, Pelecypoda, new monotid: Imlay, Ralph W. 00644
*Montana*
Great Falls Lewistown coal field, paleogeography: Silverman, Arnold J. 00853
*Oregon*
Northeastern, Pelecypoda, new monotid: Imlay, Ralph W. 00644
*Utah*
Escalante Upper Valley area, Straight Cliffs Sandstone coal sections: Doelling, Hellmut H. 00815

**Kansas**
*Areal geology*
Shawnee County, eastern and vicinity: Johnson, William D., Jr. 00637
Shawnee County, western and vicinity: Johnson, William D., Jr. 00737
*Engineering geology*
Lyons salt mine, rock mechanics: McClain, W. C. 00806
*Petrology*
Riley County, kimberlite pipes: Brookins, Douglas G. 00816

**Kentucky**
*Economic geology*
Coal, natural gas, West Liberty quadrangle: Englund, Kenneth J. 00650
Coal, petroleum, Fallsburg quadrangle: Sharps, Joseph A. 00839
Fluorspar, limestone, Fredonia quadrangle: Rogers, William B. 00830
*Maps, geologic*
Fallsburg quadrangle: Sharps, Joseph A. 00839
Fredonia quadrangle: Rogers, William B. 00830
West Liberty quadrangle: Englund, Kenneth J. 00650
*Stratigraphy*
Carboniferous, Quaternary, Fallsburg quadrangle, section: Sharps, Joseph A. 00839
Carboniferous, Quaternary, Fredonia quadrangle, sections: Rogers, William B. 00830
Carboniferous, Quaternary, West Liberty quadrangle, section: Englund, Kenneth J. 00650
Pennsylvanian, Upper, western coal field, correlation with Illinois: Smith, W. H. 00873

**Krypton**
*Isotopes*
Anomalies, achondritic meteorites: Bogard, D. D. 00684

**Lake Superior region**
*Geochemistry*
Lake sediments and water, Sr, Pb isotopes: Hart, Stanley R. 10674
*Geophysical surveys*
Crustal studies, 1963 experiment, detection distance: Bancroft, A. M. 10708
Crustal studies, seismic, 1963: Steinhart, John S. 10676
Crustal studies, seismic, 1963–64 experiment: Bednarek, A. R. 10675
Crustal studies, seismic, 1963–64 experiment: Mereu, R. F. 10672
Crustal studies, seismic, analytic techniques: Smith, T. Jefferson. 10704
Crustal studies, seismic, attenuation and spectral measurements: Willis, David E. 10692
Crustal studies, seismic, frequency spectra: Howell, B. F., Jr. 10693
Crustal studies, seismic, gravity: Steinhart, John S. 10705
Crustal studies, seismic, long range data, 1963–64: Mansfield, R. H. 10670
Crustal studies, seismic, time term interpretation: Berry, M. J. 10703
Gravity, underwater, cf. seismic: Weber, J. R. 10709
Isle Royale Keweenaw Peninsula, gravity: White, Walter S. 10706
Keweenaw area, gravity, magnetic: Bacon, L. O. 10711
Seismic, underwater sound measurements: DeNoyer, John M. 10694
Western basin, aeromagnetic, gravity, seismic profiling: Wold, Richard J. 10710
*Maps, aeromagnetic*
Keweenaw area: Bacon, L. O. 10711
*Petrology*
Crustal facies: Ringwood, A. E. 10682
*Sedimentary petrology*
Western basin, Precambrian, upper Keweenawan: White, Walter S. 10706
*Stratigraphy*
Precambrian: Halls, H. C. 10689
*Structural geology*
Crustal, seismic and gravity studies: Steinhart, John S. 10705
Crustal, seismic study, analytic techniques: Smith, T. Jefferson. 10704
General: Halls, H. C. 10689
Keweenaw area, faults, gravity and magnetic data: Bacon, L. O. 10711
Western basin: White, Walter S. 10706
*Volcanology*
Precambrian: Halls, H. C. 10689

**Lakes, extinct**
*Alberta*
Iosegun Lake area: Saint Onge, D. A. 00904

**Lead**
*Abundance*
Sea water, Atlantic, cf. Pacific and Mediterranean: Chow, Tsaihwa J. 10784

**Lead**
*Analysis*
Mass spectrometry, triple-filament solid-sample method: Catanzaro, E. J. 00880
*Isotopes*
Composition in feldspar, granitic rocks, North America: Tilton, George R. 10851
Ratios, galena, stratiform cf. vein ore deposits: Ostic, R. G. 00888
*United States*
Reserves, 1964, distribution by region: Everett, F. D. 00872

**Limestone**
*Kentucky*
Fredonia quadrangle, resources: Rogers, William B. 00830
*Tennessee*
Aspen Hill quadrangle, resources: McCary, Charles E. L. 00825
Boyds Creek quadrangle, resources: Swingle, George D. 00922

**Lithium**
*Analysis*
Fluorometric, with dibenzothiazolylmethane, in salts: Pitts, A. E. 00844
*Manitoba*
Bernic Lake pegmatite, reserves: Howe, A. C. A. 00813

**Louisiana**
*Paleontology*
Foraminifera, Miocene, correlation: Rainwater, E. H. 10715

**Magmas**
*Differentiation*
Immiscible liquids: McDonald, J. A. 00799
Lateral variation, oceanic to continental, circum-Pacific belt: Kuno, Hisashi. 10802
*Genesis*
Basaltic, oceanic to continental, circum-Pacific belt: Kuno, Hisashi. 10802
Mineralized intrusives: Moorbath, S. 00795
Tholeiitic, andesitic, eugeosynclines, island arcs: Hamilton, Warren. 10803
Virgin Islands, Saint Thomas, St. John: Donnelly, Thomas W. 10785
Volcanic, plutonic, Puerto Rico: Mattson, Peter H. 10819
*Geochemistry*
Chemical fractionation, relation to U, Th distribution in granite: Ragland, Paul C. 00706
Parental types, basalt flows, Arizona-Utah: Best, Myron G. 00654
Uranium isotope disequilibrium: Somayajulu, B. L. K. 10795

**Magnesium**
*Analysis*
Activation: Eichholz, Geoffrey G. 00747

**Magnetic field, Earth**
*Rapid variations*
Continental margins: Nagata, Takesi. 10809
*Secular variations*
Use in estimate of Earth's core motions: Kahle, Anne B. 00876

**Magnetic methods**
*Instruments*
Gradiometer, new: Pamenter, C. B. 00715
Susceptibility meter, Carey Foster in situ: Hood, P. J. 00780

**Magnetic properties**
*Franklinite*
Constituents, New Jersey: Barsanov, G. P. 10717
*Instruments*
Spinner magnetometer, with fluxgate gradiometer: Foster, John H. 10719
*Measurements*
Appalachians, Paleozoic rocks, anisotropy: Graham, John W. 10684

**Magnetic surveys**
*Arctic Ocean*
Chukchi Cap, anomaly: Hunkins, Kenneth. 10818
*California*
Northern, airborne: Griscom, Andrew. 10760
*Hawaii*
Hawaiian Ridge, volcanological implications: Malahoff, A. 10864
Puna submarine ridge: Malahoff, Alexander. 00627
*Lake Superior region*
Keweenaw area, airborne, structure: Bacon, L. O. 10711
Western basin, airborne: Wold, Richard J. 10710
*Newfoundland*
Grand Banks: Hood, Peter. 10739
*North America*
Atlantic Shelf anomaly, interpretation: Geddes, Wilburt H. 10821
*Nova Scotia*
Scotia shelf: Hood, Peter. 10739
*Ontario*
Briarcliffe Lake magnetite deposit, susceptibility measurements: Hood, P. J. 00780
*Pacific Ocean*
Aleutian Trench, anomalies: Peter, George. 10815
*United States*
Washington, D. C., to San Francisco, aeromagnetic profiles, crustal study: Zietz, Isidore. 10812
*Utah*
Iron Springs district, airborne, interpretation: Blank, H. Richard, Jr. 00841
*Washington*
Puget Sound earthquake zone: Kaarsberg, Ernest A. 00775
*Wisconsin*
Airborne, correlation with geology: Patenaude, Robert W. 10707

**Major-element analyses**
*Allophane*
California, Mariposa County: Snetsinger, Kenneth G. 00728
*Ground water*
Ohio, Portage County: Winslow, John D. 10847

**Major-element analyses**
*Marine sediments*
Caribbean Sea, carbonate: Yalkovsky, Ralph. 00628
*Microcline*
Colorado, Eldora stock, contact aureole: Wright, Thomas L. 00732
*Orthoclase*
Colorado, Eldora stock, contact aureole: Wright, Thomas L. 00732
*Silver manganese minerals*
Nevada, electron probe: Radtke, Arthur S. 00792
*Spherules*
Arctic, Antarctic ice deposits, electron probe: Hodge, Paul W. 00776
*Tektites*
Martha's Vineyard, Georgia: Cuttitta, Frank. 00777
*Vermiculite*
Montana, Libby area: Boss, B. D. 00724
*Volcanics*
Nevada, southern, silicic glass: Noble, Donald C. 00709
**Mammalia**
*Cynomys vetus*
Pleistocene, Texas, Lubbock County, Slaton quarry: Dalquest, Walter W. 00782
*Equus*
Pleistocene, Texas, Lubbock County, Slaton quarry: Dalquest, Walter W. 00782
*Neotiber leonardi*
Pleistocene, Texas, Lubbock County, Slaton quarry: Dalquest, Walter W. 00782
*Quaternary*
Texas, Pleistocene, Lubbock County, Slaton local fauna: Dalquest, Walter W. 00782
**Manganese**
*Geochemistry*
Marine sediments: Wangersky, Peter J. 00632
Silver compounds, occurrence: Radtke, Arthur S. 00792
*Ocean floor*
Nodules and coatings on rocks, general: MacDonald, Gordon J. F. 00774
**Manitoba**
*Economic geology*
Pegmatite, Bernic Lake, cesium and lithium reserves: Howe, A. C. A. 00813
*Structural geology*
Churchill area, recent uplift, rates: Barnett, D. M. 10893
**Mantle**
*Canada*
Structure, eastern coast, seismic, gravity studies: Dainty, A. M. 10687
*Elastic waves*
Sa phase, velocity variations, shield areas: Brune, James N. 10811
S waves, amplitude, traveltime, Gutenberg Bullen A' model: Landisman, Mark. 10701
Upper, propagation, Wisconsin to Colorado: Roller, J. C. 10695
**Mantle**
*Experimental studies*
Core boundary, insulator-to-metal transition: Samara, George A. 00671
Olivine-spinel melting relations, pressure effect: Akimoto, Syun-Iti. 00675
*Pacific Ocean*
Hawaiian ridge, trench, rise, relations to crust: Woollard, G. P. 10801
*Physical properties*
Conductivity, earth currents: Nagata, Takesi. 10809
Elasticity, depth dependence: Gordon, R. B. 10860
*Processes*
Creep and seismic attenuation, cause, depth dependence: Gordon, R. B. 10860
*Structure*
Seismic studies, 1960-65, worldwide, review: James, David E. 10671
**Marble**
*Nevada*
Kingsley mining district, possibilities: Steininger, Roger. 00645
**Marine geology**
*Atlantic Ocean*
Gravity tectonics, Blake Outer Ridge: Andrews, James E. 00809
Greenland basin, crust, structure: Demenitskaya, R. M. 10796
Sediments, carbonate, geochemistry: Wangersky, Peter J. 00632
*Bottom features*
Mexico, Veracruz, Isla de Lobos reef complex: Rigby, J. Keith. 00647
Pacific Ocean, Cobb and Gorda Rises: McManus, Dean A. 00689
Spiral markings, source unknown: Hulsemann, Jobst. 10778
*Caribbean Sea*
Sediments, carbonate, geochemistry: Wangersky, Peter J. 00632
Sediments, carbonate, geochemistry: Yalkovsky, Ralph. 00628
*Gravity studies*
Midoceanic ridges, trenches, anomalies: Bowin, Carl. 10810
*Heat flow*
Continental margins, regional patterns: Lee, W. H. K. 10808
Measurement, shallow water: Lee, W. H. K. 10808
*Mineral resources*
California, offshore: Wilson, Thomas A. 10736
Placer and nodular deposits, general: MacDonald, Gordon J. F. 00774
*Sediments*
Gulf of Saint Lawrence, Laurentian channel: Conolly, J. R. 00631
*Structure*
Trenches, evolution: Worzel, J. Lamar. 10804

**Massachusetts**
*Absolute age*
North Truro quadrangle, marine shells, C 14: Koteff, Carl. 00829
*Geochemistry*
Concord River, sediments, pore water: Harriss, Robert C. 00818
*Glacial geology*
North Truro quadrangle: Koteff, Carl. 00829
Squantum area, late Paleozoic, evidence questioned: Wanless, Harold R. 10722
*Hydrogeology*
Concord River, sediments, pore water: Harriss, Robert C. 00818
*Maps, geologic*
North Truro quadrangle: Koteff, Carl. 00829
*Sedimentary petrology*
North Truro quadrangle, plains deposits, provenance: Koteff, Carl. 00829
**Mesozoic**
*Alaska*
Southeastern, plutonic events: Loney, Robert A. 00690
*California*
Sierra Nevada, Taylorsville area; correlation: McMath, Vernon E. 10769
**Metals**
*California*
Klamath Mountains, occurrence: Albers, John P. 10766
Sierra Nevada, resources: Clark, William B. 10772
*Nevada*
Kingsley mining district, occurrence: Steininger, Roger. 00645
*Ocean floor*
Placer and nodular deposits: MacDonald, Gordon J. F. 00774
*Ontario*
Feaver Lake area, potential: Fenwick, K. G. 00934
Matsonville township, District of Timiskaming, resources: Lovell, H. L. 00891
**Metamorphic rocks**
*Geochemistry*
Oxygen isotope ratios, coexisting minerals in regionally metamorphosed: Garlick, G. Donald. 00702
*Metasediments*
General description, California, Coast Ranges, Salinian block: Compton, Robert R. 10751
*Mineral assemblages*
Tremolite ferroactinolite stability: Mueller, Robert F. 00630
*Mineral facies*
California, Klamath Mountains: Davis, Gregory A. 10738
Dominican Republic, central, volcanic and keratophyric types: Bowin, Carl O. 10791
Feldspar, Colorado, Eldora stock, contact aureole: Wright, Thomas L. 00732
Greenland, Egaluit peninsula, Julianehab granite: Scharbert, Heinz G. 10712
**Metamorphic rocks**
*Mineral facies*
Lake Superior region, crustal: Ringwood, A. E. 10682
Phase equilibria, hypothetical: Hietanen, Anna. 00634
*Schist*
Geochemistry, Ontario, Grenville mica schists, staurolite bearing: Hounslow, A. W. 00910
*Serpentinite*
Physical properties, reflectance, ultraviolet: Greenman, Norman N. 00783
**Metamorphism**
*Contact*
Facies, hypothetical stability fields: Hietanen, Anna. 00634
Feldspar polymorphism, Colorado, Eldora area: Steiger, Rudolf H. 00731
Structural state of feldspars, Colorado, Boulder County: Wright, Thomas L. 00732
*Facies series*
Regional metamorphic types: Hietanen, Anna. 00634
*P–T conditions*
Amphibole series stability: Mueller, Robert F. 00630
Facies and metamorphic zones: Hietanen, Anna. 00634
*Regional*
California, Klamath Mountains: Davis, Gregory A. 10738
Equilibrium state, element distribution, Ontario, Grenville schists: Hounslow, A. W. 00910
Types, relation to metamorphic facies: Hietanen, Anna. 00634
*Retrograde*
Mixed metamorphic facies: Hietanen, Anna. 00634
*Theoretical studies*
P–T diagrams for mineral assemblages, construction: Zen, E-an. 00857
**Meteor craters**
*Quebec*
Clearwater West and Manicouagan: Bunch, T. E. 00727
**Meteorites**
*Canyon Diablo*
Diamonds, hexagonal, implications: Hanneman, R. E. 00769
*Composition*
Chondrites, excess Xe 129 and Te abundance: Kuroda, P. K. 00681
Cohenite, occurrence and origin: Brett, Robin. 00786
Enstatite chondrites, total carbon: Moore, Carleton B. 10794
Ga and Ge in irons: Wasson, John T. 00787
Irons, trace elements: Cobb, James C. 00683
*Cosmic dust*
Composition, Arctic and Antarctic spherules: Hodge, Paul W. 00776

**Meteorites**
*Enstatite chondrites*
Composition, total carbon distribution: Moore, Carleton B. 10794
*Genesis*
Te 128 - Xe 129 formation interval: Kuroda, P. K. 00681
*Goalpara*
Diamonds, hexagonal, implications: Hanneman, R. E. 00769
*Irons*
Chemical classification, Ga, Ge contents: Wasson, John T. 00787
Cosmogenic tritium problem: Fisher, David E. 00884
*Isotopes*
Krypton, achondrites: Bogard, D. D. 00684
*Organic matter*
Extraterrestrial life, evidence, review: Manten, A. A. 10720
*Physical properties*
Pressure history, irons: Jaeger, R. R. 00781
**Mexico**
*Economic geology*
Zacatecas, Fresnillo mine, metal distribution geometry: Koch, George S., Jr. 00739
*Geomorphology*
Chiapas, physiographic divisions, karst, soils: Gerstenhauer, Armin. 10724
Veracruz, Isla de Lobos reef complex: Rigby, J. Keith. 00647
*Geophysical surveys*
Baja California, continental shelf, seismic: Moore, David Gillis. 10859
*Glacial geology*
Las Delicias area, late Paleozoic, evidence questioned: Wanless, Harold R. 10722
*Marine geology*
Continental shelf, origin: Cotton, C. A. 10741
*Petrology*
Rhyolite, basalt, Socorro Island: Bryan, W. B. 10874
*Structural geology*
Recent crustal movements: Meade, Buford K. 10878
*Volcanology*
Socorro Island, history: Bryan, W. B. 10874
**Michigan**
*Economic geology*
Iron, Marquette Range, genesis: Symons, D. T. A. 00768
Iron, taconite, beneficiation: Heising, L. E. 00750
*Paleomagnetism*
Marquette Range, hard hematite ore, genesis: Symons, D. T. A. 00768
**Micropaleontology**
*Extraterrestrial*
Meteorites, evidence, review: Manten, A. A. 10720
*Methods*
Environmental analysis, Recent foraminiferal models: Sigleo, E. G. 10714
**Microseisms**
*Causes*
Reflections at M discontinuity, experimental study: Hales, Anton L. 10677
**Microwave methods**
*Instruments*
Radiometer: Conway, William. 10895
*Interpretation*
Sensor, outputs, active and passive: Peake, W. H. 10882
**Mineragraphy**
*General*
I.M.A. commission on ore microscopy: Bowie, S. H. U. 00798
*Textures*
Silver manganese ores, Nevada: Radtke, Arthur S. 00792
Taconite, liberation: Heising, L. E. 00750
**Mineral data**
*Albite*
Twinning, growth, New Mexico, Paradox Limestone: Donnelly, Thomas W. 00710
*Al$_2$SiO$_5$ polymorphs*
Stability fields, hypothetical, in regional metamorphism: Hietanen, Anna. 00634
*Amphibole*
Metamorphic, stability: Mueller, Robert F. 00630
*Anhydrite*
Phase equilibrium, geochemistry, synthetic: Hardie, Lawrence A. 00736
*Aragonite*
Far infrared spectra: Angino, Ernest E. 00733
*Astrophyllite*
Structure: Woodrow, P. J. 00823
*Autunite*
Properties, new mineral: Radtke, Arthur S. 00792
*Biotite*
Radioactivity, alpha, unknown origin: Gentry, Robert V. 10788
*Calcite*
Deformation, torsion test: Borg, Iris. 00698
Far infrared spectra: Angino, Ernest E. 00733
Synthesis, growth of single crystals: Nester, J. E. 00722
*Cheralite*
Structure, redetermination: Finney, J. J. 00738
*Cinnabar*
Solubility, hydrothermal sulfide solutions: Dickson, F. W. 10876
*Clinopyroxene*
Cell dimensions, aluminous: Lewis, John F. 00708
*Cohenite*
Occurrence and origin in meteorites: Brett, Robin. 00786
*Cordierite*
Stability field: Hietanen, Anna. 00634
*Diamonds*
Hexagonal, in meteorites, implications: Hanneman, R. E. 00769

**Mineral data**
*Feldspar*
Argon retentivity: Livingston, Donald E. 00680
Orthoclase–microcline transition, properties, geochemistry: Steiger, Rudolf H. 00731
Physical properties, composition, structural state, contact aureole: Wright, Thomas L. 00732
Polymorphism of potassic, Colorado, Eldora area: Steiger, Rudolf H. 00731
X-ray analyses, microcline–low albite and sanidine–high albite series: Orville, Philip M. 00711
*Forsterite*
Sound velocities, pressure derivatives: Schreiber, Edward. 00672
*Franklinite*
Magnetic properties, New Jersey: Barsanov, G. P. 10717
*Gypsum*
Phase equilibrium, geochemistry, synthetic: Hardie, Lawrence A. 00736
*Heulandite*
Structure, redetermination: Merkle, A. B. 00730
*Langbeinite*
Solid solution series with calcium langbeinite: Rowe, J. J. 00842
*Magnetite*
Geochemistry, trace-element contents: Theobald, P. K., Jr. 00635
*Manganese oxides*
Argentian, black calcite: Radtke, Arthur S. 00792
*Maskelynite*
Infrared absorption spectra, refractive index, Quebec, impact origin: Bunch, T. E. 00727
*Mica*
Rock-forming, chemical composition, physical properties, paragenesis: Rimsaite, J. H. Y. 00900
*Orpiment*
Solubility, hydrothermal sulfide solutions: Dickson, F. W. 10876
*Phosphate minerals*
Identification, reactions to strychnine–molybdate reagent: Kittrick, J. A. 00729
*Quartz*
New York, Herkimer County, rare habit: Chromy, Ben. 00720
Solubility, hydrothermal sulfide solutions: Dickson, F. W. 10876
Synthetic alpha, H-bonded OH, variations: Dodd, D. M. 00734
*Rutile*
Shock-wave transformation: McQueen, Robert G. 00773
*Silica*
Deposition, hot springs: Fournier, R. O. 10870

**Mineral data**
*Stibnite*
Solubility, hydrothermal sulfide solutions: Dickson, F. W. 10876
*Sulfides*
Chemical behavior, spot test detection: Chan, Frank L. 00788
*Tetradymite*
Synthesis, composition range, melting relations, X-ray data: Glatz, Alfred C. 00735
*Vermiculite*
Biotitic, composition, method of estimating: Boss, B. D. 00724
*Zircon*
Geochemistry, U, Pb isotopes, hydrothermal stability: Pidgeon, R. T. 10725

**Mineral deposits, genesis**
*Igneous processes*
Chromite, Montana: McDonald, J. A. 00799
Porphyry copper: Fournier, Robert O. 00653
Strontium isotope ratios, mineralized intrusives: Moorbath, S. 00795
*Iron*
Michigan, Marquette Range, paleomagnetic evidence: Symons, D. T. A. 00768
Ontario, Steep Rock Range, paleomagnetic evidence: Symons, D. T. A. 00768
*Lead*
Isotopic evolution, stratiform and vein ores: Ostic, R. G. 00888
*Metals*
Nevada, Kingsley mining district: Steininger, Roger. 00645
*Pegmatite*
New York, Adirondack districts and Bedford area: Tan, Li-Ping. 10779
*Phosphate*
North Carolina, Cape Fear, Frying Pan Shoals area: Pilkey, Orrin H. 00717
*Porphyry copper*
Nevada, Ely: Fournier, Robert O. 00653
Nevada, Ely: Fournier, Robert O. 00793
*Uranium*
United States, epigenetic sandstone occurrences: Finch, Warren I. 00636
*Vermiculite*
Montana, Libby area: Boettcher, A. L. 10908

**Mineral economics**
*Iron*
Taconite, beneficiation, Michigan, Wisconsin: Heising, L. F. 00750
*Mineral resources*
General: Flawn, Peter T. 10774
*Ocean floor*
Placer and nodular deposits: MacDonald, Gordon J. F. 00774

**Mineral exploration**
*Engineering problems*
Ocean environments: Craven, John P. 00785
*Geochemical methods*
Soils, A horizon: Boyle, R. W. 00797
Strontium isotope ratios, initial: Moorbath, S. 00795

**Mineral exploration**
*Geophysical methods*
Remote sensing, airborne, computer data reduction: Barringer, A. R. 10887
Remote-sensing, vapor detection: Barringer, A. R. 10880
*Metallogenic maps*
Quebec, preparation and use: Sirois, Roger. 00837
**Mineral resources**
*General*
Relation to geology, engineering, economics, politics, law: Flawn, Peter T. 10774
*New York*
Occurrences, production, economic geography: Thompson, John H. 10848
*Ocean floor*
Placer and nodular deposits: MacDonald, Gordon J. F. 00774
**Mineral zoning**
*Porphyry copper*
Aluminum silicates, Nevada: Fournier, Robert O. 00793
*Vein deposit*
Mexico, Zacatecas, Fresnillo mine: Koch, George S., Jr. 00739
**Mineralogy**
*Crystal growth*
$\alpha$-quartz, synthetic, variation of H-bonded OH: Dodd, D. M. 00734
Calcite from $CaCO_3$-$Li_2CO_3$: Nester, J. F. 00722
Gypsum, anhydrite: Hardie, Lawrence A. 00736
*Identification techniques*
Phosphate minerals, chemical: Kittrick, J. A. 00729
Sulfides, spot test detection: Chan, Frank L. 00788
**Mining geology**
*Evaluation*
Statistical methods, sampling, computer simulation: Hazen, Scott W., Jr. 10855
**Minnesota**
*Absolute age*
Morton Gneiss, biotite, Rb-Sr, K-Ar, weathering effects: Goldich, S. S. 10891
Morton Gneiss, zircon, Pb-U, weathering effect: Stern, T. W. 10793
*Geomorphology*
Winona area, interpretation, radar imagery: McAnerney, J. M. 10883
*Geophysical surveys*
Midcontinent Gravity High, seismic, crustal structure: Cohen, T. J. 10702
Winona area, radar: McAnerney, J. M. 10883
*Weathering*
Morton Gneiss, biotite, effect on isotope ages: Goldich, S. S. 10891
**Mississippian**
*Arkansas*
Ouachita Mountains, Athens Plateau, stratigraphy: Walthall, Bennie H. 00676
**Mississippian**
*Missouri*
Springfield-Branson area, stratigraphy: Vineyard, Jerry D. 00807
*Montana*
Western, Brachiopoda, Sappington Formation, zones: Gutschick, R. C. 00677
*New Brunswick*
Conodonts, Windsor Group: Globensky, Yvon. 00770
*Nova Scotia*
Conodonts, Windsor Group: Globensky, Yvon. 00770
Pugwash, Windsor Group: Evans, Robert. 00796
*Wyoming*
West-central, Madison Limestone, fauna, correlation: Sando, W. J. 00678
**Missouri**
*Areal geology*
Springfield-Branson area, guidebook: Vineyard, Jerry D. 00807
*Economic geology*
Clays, western, lower Cabaniss Subgroup, ceramic properties: Tennissen, Anthony C. 00808
*Paleontology*
Stromatoporoidea, Silurian, Devonian species: Birkhead, Paul K. 00884
**Mohorovicic discontinuity**
*Movement*
Calculation as function of time: vandeLindt, W. J. 00749
*Seismic studies*
Canada, eastern, continental margin: Keen, M. J. 10742
**Mollusca**
*Hyolithes*
Cambrian, Georgia, Conasauga shale, Floyd County: Englebright, Steven C. 00864
*Tertiary*
California, Berkeley Hills, Siesta Formation: Firby, James R. 00899
California, Kern County, San Emigdio Formation: DeLise, K. C. 00779
**Montana**
*Economic geology*
Clays, tests for usage: Chelini, J. M. 10783
Coal, Great Falls-Lewistown field: Silverman, Arnold J. 00853
Gold, Marysville stock, genesis: Mantei, Erwin J. 00694
Silica, high-purity deposits, occurrence: Chelini, J. M. 10782
*Geochemistry*
Marysville stock, gold content, variation: Mantei, Erwin J. 00694
Vermiculite, Lincoln County, Libby area, analysis method: Boss, B. D. 00724
*Geomorphology*
Beartooth Mountains, stream terraces, capture: Ritter, Dale F. 00692
*Geophysical surveys*
Crustal studies, seismic, east-west profiles: Asada, T. 10697

**Montana**
*Maps, geologic*
Beartooth Mountains, surficial: Ritter, Dale F. 00692
Great Falls Lewistown coal field: Silverman, Arnold J. 00853
*Mineralogy*
Vermiculite, hydrobiotite, Libby area, Rainy Creek biotite pyroxenite: Boettcher, A. L. 10908
Vermiculite, Lincoln County, Libby area, composition: Boss, B. D. 00724
*Paleomagnetism*
Cretaceous, Elkhorn Mountains, volcanics, southwestern: Hanna, William F. 00673
*Paleontology*
Brachiopoda, Devonian–Mississippian, Sappington Formation: Gutschick, R. C. 00677
*Petrology*
Stillwater Complex: McDonald, J. A. 00799
*Stratigraphy*
Cretaceous, Elkhorn Mountains, volcanics, correlation: Hanna, William F. 00673
Devonian–Mississippian, Sappington Formation, zonation, correlation: Gutschick, R. C. 00677
Jurassic–Cretaceous, Great Falls–Lewistown coal field: Silverman, Arnold J. 00853
*Weathering*
Libby area, Rainy Creek biotite pyroxenite, products: Boettcher, A. L. 10908

**Nebraska**
*Paleontology*
Algae, fungi, in bryozoan, Pennsylvanian, Upper: Elias, Maxim K. 10723

**Nevada**
*Areal geology*
Kingsley mining district: Steininger, Roger. 00645
*Economic geology*
Copper, Ely, Liberty pit: Fournier, Robert O. 00653
Copper, Ely, Liberty pit: Fournier, Robert O. 00793
Metals, marble, Kingsley mining district: Steininger, Roger. 00645
*Geochemistry*
Southern, volcanic glass, silicic, analyses: Noble, Donald C. 00709
*Geophysical surveys*
Basin and Range province, seismic, crustal studies: Hill, D. P. 10685
*Maps, geologic*
Paiute Ridge quadrangle: Byers, F. M., Jr. 00838
*Maps, mineral resources*
Gold producing districts: Bonham, H. F. 00847
Silver producing districts: Bonham, H. F. 00848

**Nevada**
*Mineralogy*
Manganese oxides, argentian: Radtke, Arthur S. 00792
*Petrology*
Ely, monzonite porphyry: Fournier, Robert O. 00653
*Stratigraphy*
Paiute Ridge quadrangle, sections: Byers, F. M., Jr. 00838
*Weathering*
Southern, volcanic glass, hydration, ground water: Noble, Donald C. 00709

**New Brunswick**
*Economic geology*
Lead, Bathurst–Newcastle district, geochemistry: Ostic, R. G. 00888
*Paleontology*
Conodonts, Mississippian, Windsor Group, fauna: Globensky, Yvon. 00770

**New England**
*Geochemistry*
Coastal areas, marine algae, sediments, normal paraffin distribution: Clark, R. C., Jr. 00846
*Hydrogeology*
Connecticut River basin, ground water favorability: Cederstrom, D. J. 00905
*Maps, ground water*
Connecticut River basin: Cederstrom, D. J. 00905

**New Jersey**
*Engineering geology*
Materials, properties, New Brunswick Shale: Jumikis, Alfreds R. 10830
Shorelines, Atlantic, transport, wave energy correlation: Fairchild, John C. 10857
*Maps, geologic*
Bloomsbury quadrangle: Drake, Avery Ala, Jr. 00828
Easton (Pa.) quadrangle: Drake, Avery Ala, Jr. 00827
*Mineralogy*
Franklinite, Franklin Furnace, magnetic properties: Barsanov, G. P. 10717
*Stratigraphy*
Precambrian–Ordovician, Triassic, Bloomsbury quadrangle, sections: Drake, Avery Ala, Jr. 00828
Precambrian–Ordovician, Triassic, Easton (Pa.) quadrangle, sections: Drake, Avery Ala, Jr. 00827

**New Mexico**
*Absolute age*
Mineralized intrusives: Moorbath, S. 00795
*Mineralogy*
Albite twins, Paradox Limestone: Donnelly, Thomas W. 00710
*Petrology*
Jemez Mountains, Bandelier Tuff, conditions of eruption: Smith, R. L. 10869

**New York**
*Engineering geology*
Shorelines, Atlantic, transport, wave energy correlation: Fairchild, John C. 10857
*General*
Textbook, geography: Thompson, John H. 10848
*Geochemistry*
Kingston, Esopus Formation, trace element variation: Fenner, P. 00704
Seneca Lake, sediments, pore water, silica and chloride: Harriss, Robert C. 00818
*Geomorphology*
Physiographic regions: Cressey, George B. 10844
Soils, regional types: del Aubenfels, David J. 10849
Tug Hill Plateau, drainage pattern, Salmon River: Graham, R. S. 00865
*Glacial geology*
Summary, preglacial background: Cressey, George B. 10844
*Hydrogeology*
Seneca Lake, sediments, pore water, silica and chloride: Harriss, Robert C. 00818
*Mineralogy*
Pegmatite deposits, Adirondack districts and Bedford area: Tan, Li Ping. 10779
Quartz: Herkimer County, rare habit: Chromy, Ben. 00720
*Petrology*
Pegmatite deposits: Tan, Li Ping. 10779
*Stratigraphy*
Ordovician, Esopus Formation, Kingston: Fenner, P. 00704

**Newfoundland**
*Geophysical surveys*
Grand Banks, magnetic: Hood, Peter. 10739
*Maps, geologic*: Williams, H. 00821
*Stratigraphy*
Paleozoic, northeastern, correlation with British Isles: Kay, Marshall. 00658
*Structural geology*
Northeastern, correlation with British Isles: Kay, Marshall. 00658
Transcurrent faults, relation to Ireland, Scotland: Kay, Marshall. 10854

**Nodules**
*Spherules*
Arctic, Antarctic ice deposits, compositions: Hodge, Paul W. 00776

**North America**
*Geochemistry*
Tektites, Martha's Vineyard, Georgia, analyses of: others; Cuttitta, Frank. 00777
*Geophysical surveys*
Atlantic Shelf, magnetic anomaly: Geddes, Wilbart H. 10821
Eastern, continental margin, seismic: Drake, Charles L. 10820
*Stratigraphy*
Paleogeography, Pelecypoda, taxonomic diversity as key: Stehli, F. G. 00693

**North America**
*Structural geology*
Eastern, continental margin, cf. Appalachian geosyncline: Drake, Charles L. 10820
Northern margin, crust, relation to Arctic Ocean crust: Roots, E. F. 10817

**North Carolina**
*Economic geology*
Phosphate, Frying Pan Shoals area: Pilkey, Orrin H. 00717
*Geochemistry*
Neuse River, sediments, pore water, silica and chloride: Harriss, Robert C. 00818
Piedmont, trace element distribution, detrital magnetite: Theobald, P. K., Jr. 00635
*Hydrogeology*
Neuse River, sediments, pore water, silica and chloride: Harriss, Robert C. 00818

**Northwest Territories**
*Maps, aeromagnetic*
Mackenzie, Ford Lake area: Canada Geological Survey. 00651
*Stratigraphy*
Ordovician, Silurian, graptolitic facies: Jackson, D. E. 10909

**Nova Scotia**
*Economic geology*
Evaporites, Pugwash, structure: Evans, Robert. 00796
*Geophysical surveys*
Scotia shelf, magnetic: Hood, Peter. 10739
*Paleontology*
Conodonts, Mississippian, Windsor Group, fauna: Globensky, Yvon. 00770
*Structural geology*
Pugwash, salt tectonics: Evans, Robert. 00796

**Nuclear explosions**
*Salmon*
Near surface spalling: Eisler, J. D. 00915

**Oceanography**
*Practice*
Surface and undersea environments, engineering problems: Craven, John P. 00785

**Ohio**
*Hydrogeology*
Portage County: Winslow, John D. 10847
*Maps, geologic*
Portage County, subsurface and surficial: Winslow, John D. 10847
*Maps, ground water*
Portage County: Winslow, John D. 10847
*Stratigraphy*
Devonian, Mississippian, Quaternary, Portage County: Winslow, John D. 10847

**Oil and gas fields**
*Oklahoma*
North Goteebo gas field, cross sections: Takken, Suzanne. 00713
*Texas*
Southern, serpentine plug fields: Simmons, Kenneth A. 00719

**Oil shale**
*Canada*
Hudson Bay basin, Silurian occurrence: Nelson, S. J. 10914
*Colorado*
Green River Formation, oil gravity, trend-surface analysis: Smith, John W. 10856
**Oklahoma**
*Economic geology*
Natural gas, North Gotebo area: Takken, Suzanne. 00713
*Engineering geology*
Water quality control, Arkansas–Cimarron River basins: U.S. Army Corps of Engineers. 10673
*Hydrogeology*
Arkansas–Cimarron River basins, ground-water quality control: U.S. Army Corps of Engineers. 10673
*Paleomagnetism*
Wichita Mountains, Cambrian basement: Ku, Chao-Cheng. 00674
*Paleontology*
Plant marking, Pleistocene dune sand, Wichita Mts.: Bartenstein, Helmut. 10806
Trilobita, Devonian, Haragan Formation, *Neoprobolium*: Goke, Gerhard. 00860
*Sedimentary petrology*
Wichita Mountains, Pleistocene dune sand, wind-blown plant scar: Bartenstein, Helmut. 10806
*Stratigraphy*
Pennsylvanian, Marmaton Group, northeastern: Cole, J. Glenn. 00712
*Structural geology*
North Gotebo area, subsurface, natural gas trap: Takken, Suzanne. 00713
**Ontario**
*Areal geology*
Bluffy Lake area: Fenwick, K. G. 00935
Feaver Lake area: Fenwick, K. G. 00934
French Narrows area: Davies, J. C. 00941
Glasgow township, District of Algoma: Riley, R. A. 00937
Hutton township, District of Sudbury: Meyn, H. D. 00921
Maisonville township, District of Timiskaming: Lovell, H. L. 00891
Meath township, District of Algoma: Riley, R. A. 00925
Obonga Lake area, eastern: Kustra, C. R. 00907
Obonga Lake area, western: Kustra, C. R. 00890
Parkin township, District of Sudbury: Meyn, H. D. 00920
Rennie township, District of Sudbury: Riley, R. A. 00926
Vermilion Lake area, North Pines sheet: Johnston, F. J. 00885
Whitemud Lake area: Fenwick, K. G. 00936
*Economic geology*
Gold, Birch–Uchi Lakes area, occurrence, genesis: Goodwin, A. M. 00883
**Ontario**
*Economic geology*
Iron, Steep Rock Range, genesis: Symons, D. T. A. 00768
Lead, Manitouwadge area, geochemistry: Ostic, R. G. 00888
*Engineering geology*
Permafrost, sporadic, Ottawa, effect of surface conditions: Gold, L. W. 00896
*Geochemistry*
Cobalt area, Silverfields mine, silver–antimony phases, composition: Halls, C. 00928
Cobalt, geochemical prospecting: Boyle, R. W. 00797
Fernleigh area, element distribution, Grenville mica schists: Hounslow, A. W. 00910
*Geophysical surveys*
Briarcliffe Lake magnetite deposit, magnetic: Hood, P. J. 00780
*Hydrogeology*
Southern, soils, effects on streamflow and ground-water recharge: Ayers, H. D. 00892
*Maps, geologic*
Bluffy Lake area: Fenwick, K. G. 00935
Brampton area, east sheet: Hewitt, D. F. 00851
Brampton area, west sheet: Hewitt, D. F. 00850
Burwash sheet: Lumbers, S. B. 00852
Chapleau–Foleyet sheet: Carlson, H. D. 00909
Feaver Lake area: Fenwick, K. G. 00934
French Narrows area: Davies, J. C. 00941
Glasgow township, District of Algoma: Riley, R. A. 00937
Hearst sheet: Bennett, G. 00916
Hutton township, District of Sudbury: Meyn, H. D. 00921
Kapuskasing sheet: Bennett, G. 00924
Lac Seul sheet: Davies, J. C. 00939
Little Long Rapids sheet: Bennett, G. 00944
Maisonville township, District of Timiskaming: Lovell, H. L. 00891
Meath township, District of Algoma: Riley, R. A. 00925
Obonga Lake area, eastern: Kustra, C. R. 00907
Obonga Lake area, western: Kustra, C. R. 00890
Parkin township, District of Sudbury: Meyn, H. D. 00920
Pivabiska River sheet: Bennett, G. 00943
Rennie township, District of Sudbury: Riley, R. A. 00926
Sudbury mining area: Card, K. D. 00849
Tomiko sheet: Lumbers, S. B. 00908
Trout Lake–Birch Lake sheet: Davies, J. C. 00940
Vermilion Lake area, North Pines sheet: Johnston, F. J. 00885
Whitemud Lake area: Fenwick, K. G. 00936
*Maps, magnetic*
Briarcliffe Lake magnetite deposit, in situ strip results: Hood, P. J. 00780

**Ontario**
*Maps, mineral resources*
Brampton area, east sheet, industrial minerals: Hewitt, D. F. 00851
Brampton area, west sheet, industrial minerals: Hewitt, D. F. 00850
Sudbury mining area: Card, K. D. 00849
*Paleomagnetism*
Precambrian, diabase dike swarm, Sudbury area: Larochelle, A. 00887
Steep Rock Range, hard goethite ore, genesis: Symons, D. T. A. 00768
*Paleontology*
Conodonts, Ordovician, Chaumont Formation, Ottawa Valley: Barnes, Christopher R. 00894
Fossils, problematic, Precambrian, Elliot Lake area: Hofmann, H. J. 00752
*Petrology*
Birch–Uchi Lakes area, Precambrian greenstones: Goodwin, A. M. 00883
Elliot Lake–Blind River area, Archean rocks: Robertson, James A. 00911
*Sedimentary petrology*
Tilbury gas field, carbonate evaporite sequence: Quillian, R. G. 00714
*Stratigraphy*
Elliot Lake–Blind River area: Robertson, James A. 00911
Ordovician, Wilderness limestones, Chaumont Formation, Ottawa Valley: Barnes, Christopher R. 00894
Precambrian, Birch–Uchi Lakes area: Goodwin, A. M. 00883
*Structural geology*
Ottawa area, Queensway folds, mechanics: Norris, D. K. 00893
**Ordovician**
*Alberta*
Jasper area, stratigraphy: Slind, O. L. 10910
Rocky Mountains, cyclic sedimentation: Aitken, J. D. 10911
*British Columbia*
Glenogle area, biostratigraphy: Larson, M. L. 10916
Pine River area, stratigraphy: Slind, O. L. 10910
*Canada*
Cordillera–Arctic Archipelago, graptolitic facies: Jackson, D. E. 10909
*Missouri*
Springfield–Branson area, stratigraphy: Vineyard, Jerry D. 00807
*Ontario*
Ottawa Valley, Wilderness limestones, Chaumont Formation: Barnes, Christopher R. 00894
**Oregon**
*Hydrogeology*
Baker Valley, ground water resources and quality: Lystrom, D. J. 00822
*Maps, ground water*
Baker Valley: Lystrom, D. J. 00822
**Oregon**
*Paleontology*
Pelecypoda, Mesozoic, Pliensbachian, eastern, new monotid: Imlay, Ralph W. 00644
*Stratigraphy*
Cretaceous, Upper, southern, unconformity: Peterson, Gary L. 00679
**Organic materials**
*General*
Meteorites, extraterrestrial life, review: Manten, A. A. 10720
*Hydrocarbons*
Marine algae and sediments, normal paraffin distribution: Clark, R. C., Jr. 00846
**Orogeny**
*Laramide*
Colorado, Eldorado Springs quadrangle: Wells, John D. 00858
**Ostracoda**
*Cenozoic*
Panama, recent sediments, Colon Harbour area, cf. Brady fauna: Bold, W. A. van den. 10780
*Reussicythere, n.gen.*
Recent, Panama, Colon Harbour area: Bold, W. A. van den. 10780
*Ruggieria dictyon, n.sp.*
Recent, Panama, Colon Harbour area: Bold, W. A. van den. 10780
**Oxygen**
*Isotopes*
O 18/O 16, Caribbean cores, sedimentation rates from variation: Kemp, Warren C. 00670
Ratios, coexisting minerals of regionally metamorphosed rocks: Garlick, G. Donald. 00702
Ratios, igneous rocks: Garlick, G. Donald. 10792
**Pacific Ocean**
*Geomorphology*
Northeastern, Cobb and Gorda Rises: McManus, Dean A. 00689
*Geophysical surveys*
Aleutian Trench, magnetic, gravity: Peter, George. 10815
Eastern, border trenches, North America, seismic: Shor, George G., Jr. 10814
Hawaiian Islands arc, crustal studies, seismic, gravity: Woollard, G. P. 10801
Mendocino escarpment, eastern, gravity, interpretation: Dehlinger, Peter. 00868
*Paleomagnetism*
Cenozoic, deep sea sediments, northern: Dickson, G. O. 10718
Quaternary, deep sea sediments, northern: Ninkovich, Dragoslav. 10789
*Petrology*
Circum-Pacific belt, basalt magma, lateral variation: Kuno, Hisashi. 10802
*Sedimentary petrology*
Quaternary sediments, sedimentation rates, tephrachronology: Ninkovich, Dragoslav. 10789

**Pacific Ocean**
*Structural geology*
Aleutian Trench, crust, model: Peter, George, 10815
Eastern, border trenches, North America: Shor, George C., Jr. 10814
**Paleoclimatology**
*Temperatures*
Quaternary, Atlantic Ocean, Caribbean Sea, sediments: Wangersky, Peter J. 00632
Quaternary, Caribbean Sea sediments: Yalkovsky, Ralph, 00628
**Paleoecology**
*Bryozoa*
Ectoprocta, Ordovician, Pennsylvanian, infested by algae and fungi: Elias, Maxim K. 10723
*Indicators*
Foraminifera, Recent quantitative models: Stehli, F. G. 10714
*Tertiary*
Bathyal to littoral, California, Kern County: DeLise, K. C. 00779
**Paleogeography**
*Mapping methods*
Equator and pole positions, bivalvia diversity: Stehli, F. G. 00693
*Quaternary*
Alaska, Bering land bridge, late Wisconsin: Colinvaux, Paul A. 00700
Florida, southern, adjacent coasts: Scholl, David W. 00682
*Tertiary*
Florida, Pliocene, sea level, vertebrate evidence: Webb, S. David 00703
Jamaica: Robinson, E. 00657
**Paleomagnetism**
*Applications*
Iron ore genesis, Michigan and Ontario: Symons, D. T. A. 00768
*Cambrian*
Oklahoma, Wichita Mountains, basement: Ku, Chao Cheng, 00674
*Carboniferous*
Atlantic Ocean opening: Wells, John M. 00875
*Cretaceous*
Montana, Elkhorn Mountains, volcanics: Hanna, William F. 00673
*Geochronology*
Cretaceous, Tertiary, Montana: Hanna, William F. 00673
*Instruments*
Spinner magnetometer, with fluxgate gradiometer: Foster, John H. 10719
*Paleozoic*
United States, western, Kiaman interval: McMahon, Beverly E. 00666
*Permian*
Atlantic Ocean opening: Wells, John M. 00875
*Pole positions*
Cambrian, Oklahoma, Wichita Mts., basement: Ku, Chao Cheng, 00674
**Paleomagnetism**
*Pole positions*
Paleozoic, late, opening of Atlantic Ocean: Wells, John M. 00875
Precambrian, Ontario, Sudbury diabase dikes: Larochelle, A. 00887
Wandering, foraminiferal ecology as indicators: Stehli, F. G. 10714
*Precambrian*
Ontario, Sudbury diabase dikes: Larochelle, A. 00887
*Quaternary*
Pacific Ocean, northern, deep sea cores: Ninkovich, Dragoslav, 10789
*Reversals*
Cenozoic events, Pacific Ocean, northern, sediment core: Dickson, G. O. 10718
**Paleontology**
*Environmental analyses*
Taxonomic diversity, relation to paleogeography: Stehli, F. G. 00693
*Methods*
Foraminiferal ecology, Recent quantitative models, applications: Stehli, F. G. 10714
*Taxonomy*
Echinodermata, Helicoplacoidea: Durham, J. Wyatt, 00771
**Paleozoic**
*California*
Sierra Nevada, Taylorsville area, nomenclature, correlation: McMath, Vernon E. 10769
*Canada*
Hudson Bay basin, stratigraphy: Nelson, S. J. 10914
*Newfoundland*
Notre Dame Bay, stratigraphy: Kay, Marshall, 00658
*World*
Glaciation, late, evidence, review: Wanless, Harold R. 10722
**Palynology**
*Quaternary*
Alaska, Pribilofs, late Wisconsin: Colinvaux, Paul A. 00700
**Panama**
*Engineering geology*
Canal Zone, weak shales, residual shear strength: Herrmann, H. G. 10918
*Paleontology*
Foraminifera, Miocene, Burica Formation, new species: Seiglie, George A. 10877
Ostracoda, Recent, Colon Harbour area: Bold, W. A. van den, 10780
**Paragenesis**
*Anhydrite*
Interpretation, experimental data: Hardie, Lawrence A. 00736
*Gypsum*
Interpretation, experimental data: Hardie, Lawrence A. 00736
*Mica*
Interpretation: Rimsaite, J. H. Y. 00900

**Paragenesis**
*Silver ores*
Black calcite, inclusions, Nevada: Radtke, Arthur S. 00792
**Pegmatite**
*New York*
Adirondack districts and Bedford area, occurrence: Tan, Li Ping. 10779
**Pelecypoda**
*Inodonta nuttalliana lignitica*
Phocene, California, Siesta Formation: Firby, James R. 00899
*Geographic distribution*
Taxonomic diversity, worldwide, key to paleogeography: Stehli, F. G. 00693
*Lapherella boechiformis n.gen.*
Mesozoic, California, Oregon, Pliensbachian, description: Imlay, Ralph W. 00644
*Otapiria*
Mesozoic, Alaska, systematic descriptions: Imlay, Ralph W. 00644
*Otapiria tailleuri, n.sp.*
Jurassic, Alaska: Imlay, Ralph W. 00644
*Penitella*
Tertiary, North America, west coast: Adegoke, Oluwafeyisola S. 00898
*Platyodon*
Tertiary, North America, west coast: Adegoke, Oluwafeyisola S. 00898
*Platyodon clarki, n.sp.*
Miocene, California, San Pablo Group: Adegoke, Oluwafeyisola S. 00898
*Platyodon pecki, n.sp.*
Oligocene, California, San Ramon Formation: Adegoke, Oluwafeyisola S. 00898
*Recent*
Worldwide, taxonomic diversity, relation to geography: Stehli, F. G. 00693
*Sphaerium cynodon*
Phocene, California, Siesta Formation: Firby, James R. 00899
**Pennsylvania**
*Maps, geologic*
Easton quadrangle: Drake, Avery Ala, Jr. 00827
*Stratigraphy*
Precambrian-Ordovician, Triassic, Easton quadrangle, sections: Drake, Avery Ala, Jr. 00827
*Structural geology*
Alleghenv plateau, valley stress release, faults, fractures: Ferguson, H. F. 00913
**Pennsylvanian**
*Arkansas*
Ouachita Mountains, Athens Plateau, stratigraphy: Walthall, Bennie H. 00676
*Kansas*
Shawnee County, eastern and vicinity, stratigraphy: Johnson, William D., Jr. 00637
Shawnee County, western and vicinity, stratigraphy: Johnson, William D., Jr. 00737
**Pennsylvanian**
*Kentucky*
Western coal field, Upper, correlation with Illinois: Smith, W. H. 00873
*Oklahoma*
Northeastern, Marmaton Group: Cole, J. Glenn. 00712
**Permeability**
*Foundation rock*
Anisotropic, three hole pressure test: Snow, David T. 10928
*Limestone*
Tertiary, United States, southeastern: LeGrand, H. E. 10850
*Sandstones*
Cryptostructure effects, stereoscopic radiography: Rutledge, J. Raymond. 00656
*Sedimentary rocks*
Pore structure vs. fluid flow, model study: Fatt, Irving. 00721
**Permian**
*Arizona*
Northern, Kaibab Limestone, Porifera: Griffin, Leland R. 00655
*British Columbia*
Peace River area, Mount Greene, Isbel Group: McGugan, Alan. 00889
*Kansas*
Shawnee County, western and vicinity, stratigraphy: Johnson, William D., Jr. 00737
**Petrofabrics**
*Experimental studies*
Microstructures, relation to physical properties: McWilliams, J. R. 10906
*Folds*
Ontario, Ottawa area, Queensway pair, flexural slip: Norris, D. K. 00893
*Methods*
Vectorial data analysis, optical data processing: Pincus, Howard J. 10831
**Petroleum**
*Alaska*
Iniskin-Tuxedni region, exploration: Detterman, Robert L. 00648
*California*
Coast Ranges, production: Davis, Lenelon F. 10754
Great Valley, resources: Hart, Earl W. 10749
*Exploration*
Computer technique, advantages: Rivette, J. F. 00716
Needs, ingenuity in thought: Halbouty, Michel T. 00870
*General*
Textbook, occurrence, genesis, engineering: Levorsen, A. I. 00791
*Kentucky*
Fallsburg quadrangle, resources: Sharps, Joseph A. 00839
*Texas*
Southern, serpentine plug fields: Simmons, Kenneth A. 00719

**Petrology**
*Methods*
Composition, mineral–bulk chemical relations, calculation: Perry, Kenneth, Jr. 00667
**Phase equilibria**
*Ag–Sb*
Ontario, Cobalt area, Silverfields mine: Halls, C. 00928
*$Bi_2Te_3$–$Bi_2S_3$*
Melting relations, tetradymite: Glatz, Alfred C. 00735
*Calcite–aragonite*
Phase diagram revised: Boettcher, A. L. 00661
*$CaSO_4$–$H_2O$*
Dependence on $H_2O$ activity: Hardie, Lawrence A. 00736
*Diopside–akermanite–nepheline*
Liquidus relationships, one atmosphere: Onuma, Kosuke. 00726
*General*
P–T diagrams, construction, geometric approach: Zen, E-an. 00857
*Gypsum–anhydrite*
Coexistence relations, experimental studies: Hardie, Lawrence A. 00736
*K–Al–Si–H–O*
Experimental studies: Fournier, Robert O. 00793
*K–Mg–Ca–S–O*
Melting and subsolidus relations: Rowe, J. J. 00842
*Microcline–low albite—sanidine–high albite*
Compositions, relation to symmetry transformations: Orville, Philip M. 00711
*Na–Al–Si–C–O*
Liquid immiscibility: VanGroos, A. F. Koster. 10740
*Nepheline–forsterite–silica–$Ca_2SiO_4$*
Basalt crystallization: Schairer, J. F. 10862
*Or–Ab*
Microcline–orthoclase transformation, Colorado, Eldora stock contact: Wright, Thomas L. 00732
*Tremolite–ferroactinolite*
Stability relations: Mueller, Robert F. 00630
**Phosphate**
*California*
Coast Ranges, occurrence, Tertiary: Dickert, Paul F. 10752
*North Carolina*
Cape Fear, Frying Pan Shoals area, possibilities: Pilkey, Orrin H. 00717
*Ocean floor*
Nodules and coatings on rocks, general: MacDonald, Gordon J. F. 00774
**Photogeology**
*Methods*
Gemini spacecraft photography: Lowman, Paul D., Jr. 10858
**Pleistocene**
*Yukon*
Saint Elias Mts., stratigraphy, glacial: Denton, George H. 00691
**Porifera**
*Actinocoelia maeandrina*
Permian, Arizona, Kaibab Limestone, Beta Member: Griffin, Leland R. 00655
**Porosity**
*Rocks*
Relation to mechanical behavior: Walsh, J. B. 10826
**Precambrian**
*Alberta*
Jasper area, stratigraphy: Slind, O. L. 10910
*British Columbia*
Pine River area, stratigraphy: Slind, O. L. 10910
*Colorado*
Front Range, northern, orogenic period, dating: Hedge, Carl E. 00687
*Greenland*
Eqaluit peninsula, Julianehab granite: Scharbert, Heinz G. 10712
*Lake Superior region*
Stratigraphy and structure: Halls, H. C. 10689
Western basin, evolution: White, Walter S. 10706
*Ontario*
Birch–Uchi Lakes area, stratigraphy, volcanic cycles: Goodwin, A. M. 00883
Elliot Lake area, fossils, problematic, Huronian Series, upper: Hofmann, H. J. 00752
Elliot Lake–Blind River area, Archean rocks: Robertson, James A. 00911
Sudbury area, diabase dike swarm, paleomagnetism: Larochelle, A. 00887
**Puerto Rico**
*Geomorphology*
Karst formation: Monroe, Watson H. 10781
Physiographic regions, textbook: Hunt, Charles B. 00790
*Petrology*
Volcanics: Mattson, Peter H. 10819
*Structural geology*
Tectonics: Mattson, Peter H. 10819
*Weathering*
Limestone, effect of soil cover: Monroe, Watson H. 10781
**Quaternary**
*Atlantic Ocean*
Sediments, carbonate: Wangersky, Peter J. 00632
*California*
Cayucos, Pleistocene, Invertebrata, absolute age: Veeh, H. Herbert. 00688
Coast Ranges, stratigraphy, general: Christensen, Mark N. 10753
Sierra Nevada, northern, stratigraphy: Durrell, Cordell. 10770
*Caribbean Sea*
Sediments: Yalkovsky, Ralph. 00628
Sediments, carbonate: Wangersky, Peter J. 00632
*Florida*
Southern, coastal subsidence: Scholl, David W. 00682

**Quaternary**
*Gulf of Saint Lawrence*
Sedimentation, Laurentian channel: Conolly, J. R. 00631
*Texas*
Gulf Coastal Plain, Pleistocene and Recent sand: Garner, L. E. 00835
Lubbock County, Mammalia, Slaton local fauna, Pleistocene: Dalquest, Walter W. 00782
**Quebec**
*Economic geology*
Metals, exploration, metallogenic map preparation: Sirois, Roger. 00837
*Geochemistry*
Abitibi area, varved silt, concretions: Warkentin, B. P. 00886
*Geomorphology*
Clearwater West and Manicouagan craters, meteorite impact origin: Bunch, T. E. 00727
*Geophysical surveys*
Lake Chibougamau, electrical : Hallof, P. G. 00930
*Mineralogy*
Abitibi area, varved silt, concretions: Warkentin, B. P. 00886
Maskelynite, Clearwater West and Manicouagan craters: Bunch, T. E. 00727
**Radar methods**
*Experimental studies*
Rocks in vacuum, applications to lunar studies: Holdsworth, D. W. 10888
*Instruments*
System to measure subsurface discontinuities: Holdsworth, D. W. 10888
*Interpretation*
Arctic terrain: Leighty, R. D. 10894
Backscatter, terrain phenomena: Ellermeier, A. K. 10889
Local geologic analysis: Rydstrom, Hubert O. 10902
Side-looking, terrain features: McAnerney, J. M. 10883
*Techniques*
Terrain relief, measurement: McAnerney, J. M. 10883
**Radar surveys**
*California*
Lavic Lake Pisgah flow area: Ellermeier, A. K. 10889
*Greenland*
Ice cap, thickness, bedrock profile: Rinker, J. N. 10881
Northwestern: Leighty, R. D. 10894
*Minnesota*
Winona area, side-looking: McAnerney, J. M. 10883
*South Dakota*
Pierre area, side-looking: McAnerney, J. M. 10883
**Radioactivity**
*Biotite*
Alpha activity of unknown origin, new type halo: Gentry, Robert V. 10788
**Radiolaria**
*Orodapis, n.gen.*
Cenozoic, Pacific Ocean sediments: Friend, Jennifer K. 00856
*Orodendrum*
Cenozoic, Pacific Ocean sediments, redefined: Friend, Jennifer K. 00856
*Oropagis, n.gen.*
Cenozoic, Pacific Ocean sediments: Friend, Jennifer K. 00856
*Oroscena*
Cenozoic, Pacific Ocean sediments, redefined: Friend, Jennifer K. 00856
*Orostaurus, n.gen.*
Cenozoic, Pacific Ocean sediments: Friend, Jennifer K. 00856
*Taxonomic review*
Cenozoic, Pacific sediments, use in stratigraphy: Friend, Jennifer K. 00856
**Reefs**
*Mexico*
Quaternary, Veracruz, Isla de Lobos and vicinity: Rigby, J. Keith. 00647
*Ontario*
Tilbury gas field: Quillian, R. G. 00714
*Tertiary*
Eocene, upper, Georgia, Screven County: Bond, T. A. 00742
**Reflectivity**
*Terrestrial materials*
Polarization characteristics: Egan, W. G. 10885
**Remote-sensing methods**
*Airborne*
Computer data reduction: Barringer, A. R. 10887
*Applications*
Mineral exploration, vapor detection: Barringer, A. R. 10880
*Education*
Needs: Schultz, Charles H. 10879
*Instruments*
Selection, applications: Fischer, William A. 10892
Vapor detection: Barringer, A. R. 10880
*Multispectral*
Applications, limitations: Colwell, Robert L. 10900
Glaciers, evaluation: Meier, Mark F. 10901
*Reflectivity*
Terrestrial materials, polarization characteristics: Egan, W. G. 10885
**Reptilia**
*Dinosauria*
Cretaceous, Utah, North Horn Formation, dinosaur eggs: Jensen, James A. 00646
**Rhode Island**
*Marine geology*
Continental shelf, origin: Cotton, C. A. 10741
**Rocky Mountains**
*Engineering geology*
Slope stability, laboratory tests, shear strength: Patton, F. D. 10825

**Salt tectonics**
*Nova Scotia*
Pugwash, Mississippian: Evans, Robert, 00796
**Sand**
*Tennessee*
Boyds Creek quadrangle, resources: Swingle, George D, 00922
*Texas*
Gulf Coastal Plain, resources: Garner, L. E, 00835
Resources, Lower Cretaceous: Fisher, W. L, 00836
**Sea water**
*Composition*
Barium, lead, concentration, Atlantic Ocean: Chow, Tsaihwa J, 10784
Salts, partial equivalent volumes, temperature dependency: Duedall, Iver W, 00814
*Geochemistry*
Salts, partial equivalent volumes, temperature dependency: Duedall, Iver W, 00814
**Sedimentary rocks**
*Carbonate rocks*
Physical properties, strength, experimental study: Handin, John, 00699
*Chalk*
Revelation of geologic history, Huxley's exposition: Huxley, Thomas Henry, 00871
*Classification*
Epiclastic vs. pyroclastic: Fisher, Richard V, 10721
*Clastics*
General description, Eocene series, California: Stauffer, Peter H, 00643
*Limestone*
Provenance, Jamaica, White Limestone Group: Robinson, E, 00657
*Lithofacies*
Oklahoma, northeastern: Cole, J. Glenn, 00712
Ontario, Tilbury gas field, carbonate evaporite facies: Quillian, R. G, 00714
Virgin Islands, Saint Croix, Cretaceous Tertiary: Whetten, John T, 10786
Wyoming, Red Peak Member of Chugwater Formation: Picard, M. Dane, 00664
*Methods*
Flotation, quartz feldspar separation: Pundareekakshudu, K, 00663
*Physical properties*
Permeability, stereoradiography: Rutledge, J. Raymond, 00656
Pore structure, relation to fluid flow, model study: Fatt, Irving, 00721
**Sedimentary structures**
*Cryptostructures*
Sandstones, effect on fluid flow: Rutledge, J. Raymond, 00656
*General*
Arkansas, Ouachita Mountains, flysch deposits: Walthall, Bennie H, 00676
Virgin Islands, Saint Croix, Mount Eagle Group: Whetten, John T, 10786
**Sedimentary structures**
*Plant marking*
Oklahoma, Wichita Mts., Pleistocene dune sand, wind action: Bartenstein, Helmut, 10806
*Slump structure*
Jamaica, White Limestone Group: Robinson, E, 00657
**Sedimentation**
*Cyclic*
Cambrian to Ordovician, Canadian Rocky Mts., southern: Aitken, J. D, 10911
*Environment*
Delta, Miocene transgressions, Gulf Coastal Plain: Rainwater, E. H, 10715
Lagoon, Ordovician carbonate banks, Ontario, Ottawa Valley: Barnes, Christopher R, 00894
*Littoral transport*
Correlation with wave energy, Atlantic coast: Fairchild, John C, 10857
*Rates*
Caribbean cores, isotope variation spectra: Kemp, Warren C, 00670
Determination, budget technique, littoral zone: Bowen, A. J, 10777
Pacific Ocean, northern: Nimkovich, Dragoslav, 10789
Settling velocities, drag equations, grain shape factor: Graf, Walter H, 10846
*Stream transport*
California, Cache Creek basin: Lustig, Lawrence K, 00906
*Turbidity currents*
Continental shelf, California and Baja California: Moore, David Gillis, 10859
**Sediments**
*Alluvium*
Clay mineralogy, Georgia, Altamaha River flood plain: Jinks, D. D, 00745
*Foraminiferal ooze*
Solution at depth, experimental study: Berger, Wolfgang H, 00701
*General*
General description, Gulf of Saint Lawrence, Laurentian channel: Conolly, J. R, 00631
*Geochemistry*
Pore water, lake and river sediment, silica and chloride: Harriss, Robert C, 00818
Spherules, Arctic, Antarctic ice deposits, analyses: Hodge, Paul W, 00776
*Methods*
Core sampler, portable, pneumatic: Walker, Bryan, 00845
Heavy mineral studies, hornblende distribution, Georgia, coastal plain: Carver, Robert E, 00862
Sign test, element distribution trend: Yalkovsky, Ralph, 00649
*Paleomagnetism*
Pacific Ocean, northern, magnetic stratigraphy: Dickson, G. O, 10718
Pacific Ocean, northern, magnetic stratigraphy: Nimkovich, Dragoslav, 10789

**Sediments**
*Provenance*
Massachusetts, North Truro quadrangle: Koteff, Carl. 00829
*Till*
Mineral composition, diamonds, United States: Gunn, Christopher B. 00626
**Seismic methods**
*Applications*
Crustal structure, history: Tuve, Merle A. 10698
*Instruments*
Seismograph, low distortion, magnetic tape recording: Sacks, I. S. 10679
Seismograph system, high frequency, field calibration: Shima, Etsuzo. 10678
*Interpretation*
Elastic wave propagation, explosions, source function: Carpenter, E. W. 00902
Lake Superior region, 1963 experiment: Smith, T. Jefferson. 10704
Reflected, refracted waves, plane parallel layers over half space: Berry, M. J. 10700
Time term of P, residuals, first arrivals: Bednarek, A. R. 10675
*Reflection*
Continental shelf, California and Baja California: Moore, David Gillis. 10859
Crustal and mantle studies: James, David E. 10671
*Refraction*
Crustal and mantle studies: James, David E. 10671
*Sonar*
General description, side scan technique: Klein, Martin. 00695
*Techniques*
Limestone terrain, cavity location: Love, Colin L. 00912
Refraction data, time term equation solution, iterative process: Mereu, R. F. 10690
Three dimensional presentation, attenuation studies: Willis, David E. 10692
**Seismic surveys**
*Alaska*
Aleutian Islands arc: Shor, George C., Jr. 10814
Crustal studies, 1955, coastal area: Hales, A. L. 10699
Northern, continental margin: Hunkins, Kenneth. 10818
*Alberta*
Rocky Mountains, southern: Bally, A. W. 10716
*Atlantic Ocean*
Blake Outer Ridge, reflection profile: Andrews, James E. 00809
Blake Plateau: Ewing, J. I. 10822
Crustal studies, Puerto Rico trench to Nares Deep: Hersey, J. B. 10798
Puerto Rico trench, profiles: Bunce, Elizabeth T. 10799
*British Columbia*
Rocky Mountains, southern: Bally, A. W. 10716
**Seismic surveys**
*California*
Sierra Nevada, Coast Ranges, refraction profiles: Eaton, Jerry P. 10761
*Canada*
Eastern coast, crust and mantle studies: Dainty, A. M. 10687
Eastern, continental margin, crust: Keen, M. J. 10742
*Caribbean Sea*
Crustal studies: Hersey, J. B. 10798
*Continental margin*
California Baja California shelf: Moore, David Gillis. 10859
*Greenland*
Ice sheet: Brockamp, B. 10930
*Gulf Coastal Plain*
Crustal studies, Mississippi embayment, western: McCamy, K. 10696
*Idaho*
Crustal studies, Snake River Plain, N S profile: Hill, D. P. 10685
*Lake Superior region*
Crustal studies, 1963 64 experiment: Bednarek, A. R. 10675
Crustal studies, 1963 64 experiment: Mereu, R. F. 10672
Crustal studies, 1963 experiment: Steinhart, John S. 10705
Crustal studies, 1963 experiment, detection distance: Bancroft, A. M. 10708
Crustal studies, 1963 64, regional variations: Mansfield, R. H. 10670
Crustal studies, analytic techniques: Smith, T. Jefferson. 10704
Crustal studies, attenuation and spectral measurements: Willis, David E. 10692
Crustal studies, frequency spectra: Howell, B. F., Jr. 10693
Crustal studies, interpretation, time term: Berry, M. J. 10703
Underwater sound measurements: DeNoyer, John M. 10694
Western basin, sub bottom profiles: Wold, Richard J. 10710
*Minnesota*
Midcontinent Gravity High, crustal structure: Cohen, T. J. 10702
*Montana*
Crustal studies, east west profiles: Asada, T. 10697
*Nevada*
Crustal studies, Basin and Range province, N S profile: Hill, D. P. 10685
*North America*
Eastern, continental margin, structure: Drake, Charles L. 10820
*Pacific Ocean*
Continental margin, California: Curray, Joseph R. 10756
Crustal studies, Hawaiian Islands arc: Woollard, G. P. 10801
Eastern, border trenches, North America: Shor, George C., Jr. 10814

**Seismic surveys**
*United States*
Isostatic gravity anomalies, crustal thickness: Woollard, G. P. 10680
Structural provinces, crustal composition and thickness: Pakiser, L. C. 10683
Wisconsin to Colorado, elastic-wave propagation, upper mantle: Roller, J. C. 10695
*West Indies*
Lesser Antilles island arc: Hurley, Robert J. 10797
*Wisconsin*
Midcontinent Gravity High, crustal structure: Cohen, T. J. 10702
*World*
Crustal studies, 1960–65, review: James, David E. 10671
**Seismology**
*Elastic waves*
Amplitudes, reflected and head, layered medium: Berry, M. J. 10700
Attenuation, mantle, cause: Gordon, R. B. 10860
$P_2$, $P_n$, angles of emergence, Lake Superior region: Mereu, R. F. 10672
Propagation, explosions, source function: Carpenter, E. W. 00902
Propagation, upper mantle, Wisconsin to Colorado: Roller, J. C. 10695
Q factor, overestimation: Press, Frank. 10691
Sa phase, velocity variations, mantle, shield areas: Brune, James N. 10811
Surface, phase velocity, continental margins: Knopoff, Leon. 00914
S-waves, amplitude, traveltime, Gutenberg-Bullen A′ model: Landisman, Mark. 10701
Velocities, Greenland icecap, interpretation: Brockamp, B. 10930
Velocities, Lake Superior region, 1963–64 experiments: Mansfield, R. H. 10670
Velocities, Massachusetts, Mt. Holyoke Range: Murphy, Vincent J. 10921
**Shale**
*Tennessee*
Boyds Creek quadrangle, resources: Swingle, George D. 00922
**Shorelines**
*Ancient*
California, Cayucos, Pleistocene: Veeh, H. Herbert. 00688
*California*
Point Arguello area, sediment transport, budget of littoral processes: Bowen, A. J. 10777
*Changes*
Florida, Big Bend area, Alligator Spit, hurricane effects: Warnke, Detlef A. 00668
**Silica**
*Montana*
High-purity deposits, occurrence: Chelini, J. M. 10782
**Silurian**
*British Columbia*
Rocky Mountains, Nonda Formation, new: Norford, B. S. 10915
*Missouri*
Stromatoporoidea, description of species: Birkhead, Paul K. 00884
*Yukon*
Royal Creek, Upper, biostratigraphy: Lenz, A. C. 10913
**Silver**
*Geochemistry*
Manganates, Nevada: Radtke, Arthur S. 00792
*United States*
Reserves in base-metal ores: Everett, F. D. 00872
**Soils**
*Engineering properties*
Slope stability, weak shales, residual shear strength: Herrmann, H. G. 10918
*Genesis*
Mexico, Chiapas: Gerstenhauer, Armin. 10724
*Geochemistry*
Trace elements, A horizon: Boyle, R. W. 00797
*Georgia*
Jasper County, Iredell loam, guide to gabbro-norite: Matthews, Vincent. 00746
*Mineralogy*
West Indies, geomorphologic units, engineering classification: Beaven, P. J. 10917
*New York*
Regional types: deLaubenfels, David J. 10849
**South Carolina**
*Geochemistry*
Piedmont, trace-element distribution, detrital magnetite: Theobald, P. K., Jr. 00635
**South Dakota**
*Economic geology*
Gold, Homestake mine, distribution, statistical analysis: Koch, George S., Jr. 00751
*Engineering geology*
Soil mechanics, Pierre Shale, laboratory tests: Herrmann, H. G. 10918
*Geomorphology*
Pierre area, landform interpretation, radar imagery: McAnerney, J. M. 10883
*Geophysical surveys*
Pierre area, radar: McAnerney, J. M. 10883
**Spectroscopy**
*Activation analysis*
Technique, aluminum and magnesium in soil and minerals: Eichholz, Geoffrey G. 00747
*Fluorescence*
Lithium, determination in salts, with dibenzothiazolylmethane: Pitts, A. E. 00844
*General*
X-ray analysis, advances, applications: Mallett, Gavin R. 10925

**Spectroscopy**
*Infrared*
α-quartz, synthetic, variation of H-bonded OH: Dodd, D. M. 00734
Calcite-aragonite group, far spectra: Angino, Ernest E. 00733
*Mass*
Technique, lead isotopes, triple-filament method: Catanzaro, E. J. 00880
*X-ray fluorescence*
Lithium with dibenzothiazolylmethane determination: Pitts, A. E. 00844
**Springs**
*Arizona*
Grand Canyon area, Stanton Cave, pirated: Reilly, P. T. 00901
*New York*
Saratoga Springs, mineral spa: Cressey, George B. 10844
**Statistical methods**
*Economic geology*
Trend-surface analysis, four variable, oil gravity, oil shale: Smith, John W. 10856
Trend-surface analysis, Mexico, Zacatecas, vein deposits: Koch, George S., Jr. 00739
Variance analysis, gold distribution, South Dakota, Homestake mine: Koch, George S., Jr. 00751
*Geochemistry*
Time-series test, marine sediments: Yalkovsky, Ralph. 00628
*Geomorphology*
Probability distributions: Shreve, Ronald L. 00633
**Stocks**
*Colorado*
Eldora area, contact metamorphism: Steiger, Rudolf H. 00731
**Stromatoporoidea**
*Devonian*
Missouri, description of species: Birkhead, Paul K. 00884
*Silurian*
Missouri, description of species: Birkhead, Paul K. 00884
**Strontium**
*Analysis*
Chemical, Sr-90, aqueous solutions free of Sr-89: Johnson, J. O. 00933
*Isotopes*
Ratios, mineralized intrusives: Moorbath, S. 00795
**Tectonics**
*Appalachian structure*
Mechanics, analysis from magnetic anisotropy: Graham, John W. 10684
*Canada*
Cordilleran region, northern, evolution: Gabrielse, H. 00895
*Continental drift*
Gondwana and Laurasia, originally equal size: Dietz, Robert S. 10733
*General*
Ocean basins, continents, growth patterns: Wilson, J. Tuzo. 10807
**Tectonics**
*Gravity sliding*
Atlantic Ocean, Blake Outer Ridge: Andrews, James E. 00809
*Island arcs*
Caribbean arc, evolution: Hamilton, Warren. 10816
Caribbean region, Princeton Univ. Dept. Geology research: Hess, H. H. 10790
Crustal blocks, size-shape significance: Brock, B. B. 10805
West Indies, Lesser Antilles arc: Hurley, Robert J. 10797
*Processes*
Continental drift, Newfoundland: Kay, Marshall. 00658
Convection currents, midoceanic ridges, trenches, evolution: Bowin, Carl. 10810
Tilting craton theory, Canadian Rocky Mts.: Aitken, J. D. 10911
*Recent deformation*
California, San Andreas fault system: Meade, Buford K. 10759
California, San Andreas fault zone: Wallace, Robert E. 00629
Crustal movements, North America: Meade, Buford K. 10878
Manitoba, Churchill area, uplift, rates: Barnett, D. M. 10893
Subsidence, Florida, southern, rate: Scholl, David W. 00682
*Rocky Mountains*
Alberta-British Columbia: Bally, A. W. 10716
*Rotation*
United States, northwestern, Nevadan orogenic belt: Taubeneck, William H. 00748
United States, northwestern, Nevadan orogenic belt: Watkins, N. D. 00867
*Vertical*
Alaska, southeastern, Tertiary: Loney, Robert A. 00690
**Tektites**
*North America*
Composition, genesis: Cuttitta, Frank. 00777
*Physical properties*
Elasticity, resonant sphere measurement technique: Soga, Naohiro. 00784
**Tellurium**
*Abundance*
Chondrites: Kuroda, P. K. 00681
**Tennessee**
*Economic geology*
Limestone, gravel, Aspen Hill quadrangle: McCary, Charles E. L. 00825
Mineral resources, Bath Springs quadrangle: Wilson, Charles W., Jr. 00942
Mineral resources, Boyds Creek quadrangle: Swingle, George D. 00922
Uranium, central, Chattanooga Shale: Hickman, R. C. 00740
*Maps, geologic*
Aspen Hill quadrangle: Wilson, Charles W., Jr. 00824
Bath Springs quadrangle: Wilson, Charles W., Jr. 00942

**Tennessee**
*Maps, geologic*
Boyds Creek quadrangle: Swingle, George D. 00938
*Stratigraphy*
Cambrian–Ordovician, Boyds Creek quadrangle, sections: Swingle, George D. 00938
**Tertiary**
*Alaska*
Southeastern, plutonic events: Loney, Robert A. 00690
*California*
Berkeley Hills, Siesta Formation, Mollusca: Firby, James R. 00899
Coast Ranges, phosphatic facies: Dickert, Paul F. 10752
Kern County, San Emigdio Formation, biostratigraphy: DeLise, K. C. 00779
Pelecypoda, *Platyodon, Penitella*: Adegoke, Oluwafeyisola S. 00898
Santa Ynez Mountains, Eocene series: Stauffer, Peter H. 00643
Sierra Nevada, central, volcanic stratigraphy: Slemmons, David B. 10771
Sierra Nevada, northern, stratigraphy: Durrell, Cordell. 10770
*Dominican Republic*
Central, stratigraphy: Bowin, Carl O. 10791
*Florida*
Paleogeography, Pliocene, middle, sea level: Webb, S. David. 00703
*Georgia*
Coastal plain, Ashburn formation, new name for Hawthorn Formation: Olson, Norman K. 00741
Screven County, upper Eocene silicified reef, fauna: Bond, T. A. 00742
*Gulf Coastal Plain*
Florida–Texas, Miocene, Foraminifera: Rainwater, E. H. 10715
*Virgin Islands*
Saint Croix, central graben, Jealousy Formation and Kingshill Marl: Whetten, John T. 10786
**Texas**
*Areal geology*
Cave Creek School quadrangle: Barnes, Virgil E. 00917
Yeager Creek quadrangle: Barnes, Virgil E. 00918
*Economic geology*
Petroleum, southern, serpentine plug fields: Simmons, Kenneth A. 00719
Sand, Gulf Coastal Plain, resources: Garner, L. E. 00835
Sand, north central, northern, west central, resources: Fisher, W. L. 00836
*Engineering geology*
Water quality control, Wichita River basin: U.S. Army Corps of Engineers. 10673
*Geochemistry*
Enchanted Rock batholith, fractionation, U, Th distribution: Ragland, Paul C. 00706
**Texas**
*Hydrogeology*
Wichita River basin, ground water quality control: U.S. Army Corps of Engineers. 10673
*Maps, geologic*
Cave Creek School quadrangle: Barnes, Virgil E. 00917
Gulf Coastal Plain, Quaternary formations: Garner, L. E. 00835
Lower Cretaceous sands and associated formations: Fisher, W. L. 00836
Lubbock sheet: Texas University Bur. Econ. Geology. 00919
Yeager Creek quadrangle: Barnes, Virgil E. 00918
*Paleontology*
Mammalia, Pleistocene, Lubbock County, Slaton local fauna: Dalquest, Walter W. 00782
*Stratigraphy*
Cretaceous, Lower, sands: Fisher, W. L. 00836
*Structural geology*
Southern, oil fields, serpentine plugs: Simmons, Kenneth A. 00719
**Thermal springs**
*Wyoming*
Yellowstone National Park, silica deposition: Fournier, R. O. 10870
**Thermodynamic properties**
*Activation energy*
Kaolinite: Brindley, G. W. 00707
*Activity*
Silica, hydrothermal alteration: Fournier, Robert O. 00793
*Free energy*
Gypsum–anhydrite transition: Hardie, Lawrence A. 00736
*Kaolinite*
Dehydroxylation: Brindley, G. W. 00707
**Thorium**
*Geochemistry*
Distribution, zoned granite batholith: Ragland, Paul C. 00706
**Trace elements**
*Abundance*
Iron meteorites: Cobb, James C. 00683
*Geochemistry*
Magnetite, detrital, regional distribution: Theobald, P. K., Jr. 00635
Water, ground, sea, surface, California: Silvey, William D. 00897
**Trace-element analyses**
*Brines*
Frequency of occurrence, California: Silvey, William D. 00897
*Esopus Formation*
New York, Kingston: Fenner, P. 00704
*Ground water*
Frequency of occurrence, California: Silvey, William D. 00897
*Magnetite*
North Carolina, South Carolina Piedmont, detrital: Theobald, P. K., Jr. 00635

**Trace-element analyses**
*Marine sediments*
Caribbean Sea, carbonate: Yalkovsky, Ralph, 00628
*Meteorites*
Irons: Cobb, James C, 00683
*Sea water*
Frequency of occurrence, California: Silvey, William D, 00897
*Silver, antimony intergrowths*
Ontario, Cobalt area, Silverfields mine, electron probe: Halls, C, 00928
*Silver, manganese minerals*
Nevada, electron probe: Radtke, Arthur S, 00792
**Tracks and trails**
*Atlantic Ocean*
Mid Atlantic Ridge, spiral markings, source unknown: Hulsemann, Jobst, 10778
*Oklahoma*
Pleistocene, dune sand, Wichita Mts., plant motion scar: Bartenstein, Helmut, 10806
**Triassic**
*Wyoming*
West central, Red Peak Member of Chugwater Formation: Picard, M. Dane, 00664
**Trilobita**
*Neoproboloium oklahomae*
Devonian, Oklahoma, Haragan Formation: Goke, Gerhard, 00860
**Trinidad**
*Maps, ground water*
General: Marshall, K. M. W, 10727
*Maps, mineral resources*
Provisional: Marshall, K. M. W, 10726
**Unconformities**
*California*
Cretaceous, Upper, northern: Peterson, Gary L, 00679
*Nova Scotia*
Pennsylvanian: Evans, Robert, 00796
*Oregon*
Cretaceous, Upper, southern: Peterson, Gary L, 00679
**United States**
*Economic geology*
Copper, lead, zinc reserves, associated gold, silver: Everett, F. D, 00872
Uranium, sandstone deposits, epigenetic occurrence: Finch, Warren I, 00636
*Geomorphology*
Physiographic regions, textbook: Hunt, Charles B, 00790
*Geophysical surveys*
Crustal studies, seismic, structural provinces, composition, thickness: Pakiser, L. C, 10683
Gravity and seismic, isostatic relations: Woollard, G. P, 10680
Washington, D. C., to San Francisco, crustal study, aeromagnetic profiles: Zietz, Isidore, 10812
**United States**
*Geophysical surveys*
Wisconsin to Colorado, seismic wave propagation, upper mantle: Roller, J. C, 10695
*Hydrogeology*
Arkansas–Red River basins, water quality control: U.S. Dept.Health, Educ., Welfare, 10669
Southeastern, Tertiary limestones, permeability and storage: LeGrand, H. E, 10850
Southern High Plains, Ogallala Formation, recharge, artificial: Hauser, V. L, 00718
*Maps, geomorphologic*
Land surface form: Hammond, Edwin H, 10926
*Paleomagnetism*
Paleozoic, late, reversal, Kiaman interval: McMahon, Beverly E, 00666
*Petrology*
Crustal composition, seismic, structural provinces: Pakiser, L. C, 10683
*Structural geology*
Isostatic relations, regional: Woollard, G. P, 10680
Northwestern, Nevadan orogenic belt, tectonic rotation: Taubeneck, William H, 00748
Northwestern, Nevadan orogenic belt, tectonic rotation: Watkins, N. D, 00867
Recent crustal movements: Meade, Buford K, 10878
**Uplifts**
*Canada*
Precambrian shield, relation to gravity field: Innes, M. J. S, 10852
*Manitoba*
Churchill area, rate: Barnett, D. M, 10893
**Uranium**
*Geochemistry*
Distribution, zoned granite batholith: Ragland, Paul C, 00706
*Isotopes*
Series disequilibrium, basalt: Somayajulu, B. L. K, 10795
*Ontario*
Elliot Lake–Blind River area, occurrence: Robertson, James A, 00911
*Reserves*
Productive capacity, future possibilities: Bell, D. D, 00826
*Tennessee*
Chattanooga Shale, central, resources: Hickman, R. C, 00740
*United States*
Occurrence, epigenetic sandstone deposits: Finch, Warren I, 00636
**Utah**
*Areal geology*
High Uintas primitive area: Crittenden, Max D., Jr, 00866

**Utah**
*Economic geology*
Coal, Escalante–Upper Valley area, occurrence: Doelling, Hellmut H. 00815
Mineral resources, High Uintas primitive area, lack of potential: Crittenden, Max D., Jr. 00866
*Geochemistry*
Grand Canyon region, Cenozoic basalts, chemical variations: Best, Myron G. 00654
*Geophysical surveys*
Iron Springs district, magnetic, airborne, interpretation: Blank, H. Richard, Jr. 00841
*Maps, aeromagnetic*
Iron Springs district: Blank, H. Richard, Jr. 00841
*Maps, geologic*
High Uintas primitive area: Crittenden, Max D., Jr. 00866
Iron Springs district, generalized: Blank, H. Richard, Jr. 00841
*Maps, mineral resources*
Escalante–Upper Valley area, coal: Doelling, Hellmut H. 00815
*Paleontology*
Reptilia, Cretaceous, North Horn Formation, central, dinosaur eggs: Jensen, James A. 00646
*Petrology*
Grand Canyon region, Cenozoic basalts, mineral variations: Best, Myron G. 00654
*Stratigraphy*
Jurassic–Cretaceous, Straight Cliffs Sandstone coal sections: Doelling, Hellmut H. 00815
**Veins**
*Metal distribution*
Trend–surface analysis, variance analysis: Koch, George S., Jr. 00739
**Vermont**
*Geochemistry*
Northern, varved silt, concretions: Warkentin, B. P. 00886
*Mineralogy*
Northern, varved silt, concretions: Warkentin, B. P. 00886
**Vertebrata**
*Tertiary*
Florida, Pliocene, low sea–level evidence: Webb, S. David. 00703
**Virgin Islands**
*Areal geology*
Saint Croix: Whetten, John T. 10786
*Maps, geologic*
Saint Croix: Whetten, John T. 10786
Saint Thomas and Saint John: Donnelly, Thomas W. 10785
*Petrology*
Saint Thomas and Saint John, igneous rocks, origin of magmas: Donnelly, Thomas W. 10785
*Stratigraphy*
Cretaceous, Saint Thomas and St. John: Donnelly, Thomas W. 10785
**Virgin Islands**
*Stratigraphy*
Cretaceous–Tertiary, Saint Croix: Whetten, John T. 10786
**Virginia**
*Marine geology*
Continental shelf, origin: Cotton, C. A. 10741
**Volcanoes**
*Costa Rica*
Irazu, 1963–65 eruption: Murata, K. J. 10861
*Hawaii*
Kilauea, deformation measurements: Decker, R. W. 10866
Kilauea, rift zones, gravity slide origin: Moore, J. G. 10871
*Washington*
Mount Rainier, activity, postglacial and future: Crandell, Dwight R. 00696
**Washington**
*Areal geology*
Simcoe Mountains volcanic area: Sheppard, Richard A. 00903
*Earthquakes*
April 29, 1965, Puget Sound, magnetic survey, epicentral area: Kaarsberg, Ernest A. 00775
*Geophysical surveys*
Puget Sound earthquake zone, magnetic: Kaarsberg, Ernest A. 00775
South Cascade Glacier, multispectral sensing tests: Meier, Mark F. 10901
*Maps, geologic*
Simcoe Mountains volcanic area: Sheppard, Richard A. 00903
*Structural geology*
Puget Sound earthquake zone, crust: Kaarsberg, Ernest A. 00775
*Volcanology*
Mount Rainier, activity, postglacial and future: Crandell, Dwight R. 00696
**Weathering**
*Minnesota*
Morton Gneiss, effect on isotope ages of biotite: Goldich, S. S. 10891
*Montana*
Rainy Creek biotite pyroxenite, Libby area, products: Boettcher, A. L. 10908
*Plagioclase*
California, Mariposa County, allophane genesis: Snetsinger, Kenneth G. 00728
*Puerto Rico*
Karst landscape, effect of soil cover: Monroe, Watson H. 10781
*Tropical climate*
Karst formation: Monroe, Watson H. 10781
**Well logging**
*Dual porosity*
Acoustical and epithermal–neutron combined: Zoeller, W. A. 10729
**Wells and drill holes**
*Hawaii*
Oahu, Ewa Coastal Plain, basalt: Stearns, Harold. 10732
*Kentucky*
Western coal field, core logs: Smith, W. H. 00873

**Wells and drill holes**
*Ohio*
Portage County, logs of test water wells: Winslow, John D. 10847
*Oklahoma*
Arkansas–Cimarron River basins, Permian strata, core logs: U.S. Army Corps of Engineers. 10673
*Texas*
Wichita River basin, Permian strata, core logs: U.S. Army Corps of Engineers. 10673
**West Indies**
*Engineering geology*
Soils, classification: Beaven, P. J. 10917
*Geophysical surveys*
Lesser Antilles island arc, seismic: Hurley, Robert J. 10797
*Mineralogy*
Clay minerals, soils, geomorphologic units: Beaven, P. J. 10917
**West Virginia**
*Economic geology*
Natural gas, Newburg sand, Upper Silurian, west central: Patchen, Douglas G. 00843
*Maps, geologic*
Prichard quadrangle (part), Fallsburg (Ky.) quadrangle: Sharps, Joseph A. 00839
**Wisconsin**
*Economic geology*
Iron, taconite, beneficiation: Heising, L. F. 00750
*Geophysical surveys*
Magnetic, airborne, correlation with geology: Patenaude, Robert W. 10707
Midcontinent Gravity High, seismic, crustal structure: Cohen, T. J. 10702
*Maps, magnetic*
Airborne: Patenaude, Robert W. 10707
**Wyoming**
*Areal geology*
Stinkingwater mining region: Fisher, Frederick S. 00662
*Engineering geology*
Highways, failure, relation to underlying soils: Duguid, James O. 00665
*Geophysical surveys*
Yellowstone National Park, hot earth, infrared: Miller, Lee D. 10884
*Maps, geologic*
Natwick SW quadrangle: McGrew, Laura W. 00831
Richeau Hills quadrangle: McGrew, Laura W. 00832
Stinkingwater mining region: Fisher, Frederick S. 00662
Wheatland NE quadrangle: McGrew, Laura W. 00833
*Paleontology*
Invertebrata, Mississippian, Madison Limestone, assemblages: Sando, W. J. 00678
*Petrology*
Stinkingwater mining region, Tertiary intrusives: Fisher, Frederick S. 00662
**Wyoming**
*Stratigraphy*
Devonian–Quaternary, Natwick SW quadrangle, section: McGrew, Laura W. 00831
Devonian–Quaternary, Richeau Hills quadrangle, section: McGrew, Laura W. 00832
Mississippian, Madison Limestone, west-central, correlation: Sando, W. J. 00678
Triassic, Red Peak Member of Chugwater Formation, west-central: Picard, M. Dane. 00664
**Xenon**
*Isotopes*
Xe-129, excess in chondrites: Kuroda, P. K. 00681
**X-ray diffraction analysis**
*Data*
Aluminian montmorillonoid, synthetic: Granquist, W. T. 00725
Cell edges, d-values, tetradymite: Glatz, Alfred C. 00735
Clays, Missouri, lower Cabaniss Subgroup: Tennissen, Anthony C. 00808
Clinopyroxene, aluminous: Lewis, John F. 00708
d-spacings from discontinuous powder reflections: Kittrick, J. A. 00723
K-feldspar, Nevada: Fournier, Robert O. 00653
Mica, rock-forming types, Canada: Rimsaite, J. H. Y. 00900
Microcline-low albite and sanidine-high albite series: Orville, Philip M. 00711
Orthoclase, microcline, Colorado, Eldora stock, contact aureole: Wright, Thomas L. 00732
Silver-manganese minerals, Nevada: Radtke, Arthur S. 00792
**X-ray radiography**
*Methods*
Stereoscopic, sandstones, fluid front, cryptostructures: Rutledge, J. Raymond. 00656
**Yukon**
*Absolute age*
Saint Elias Mts., C-14, glacial chronology: Denton, George H. 00691
*Glacial geology*
Saint Elias Mts., drift sheets, glaciation periods: Denton, George H. 00691
*Maps, aeromagnetic*
Chandindu River area: Canada Geological Survey. 00766
Coffee Creek area: Canada Geological Survey. 00760
Dawson area: Canada Geological Survey. 00765
Doyle Creek area: Canada Geological Survey. 00759
Duke River area: Canada Geological Survey. 00754
Grand Forks area: Canada Geological Survey. 00764

**Yukon**
*Maps, aeromagnetic*
Kluane River area: Canada Geological Survey, 00755
Lynx City area: Canada Geological Survey, 00758
Reindeer Mountain area: Canada Geological Survey, 00763
Sheet 115 J/D3: Canada Geological Survey, 00757
Stewart River area: Canada Geological Survey, 00762
Thistle Creek area: Canada Geological Survey, 00761
Toshingermann Lakes area: Canada Geological Survey, 00756
*Maps, geologic*
Shakwak Valley, surficial: Denton, George H, 00691
*Paleontology*
Brachiopoda, Graptolithina, Silurian, Devonian, Royal Creek: Lenz, A. C, 10913
*Stratigraphy*
Ordovician–Silurian, graptolitic facies: Jackson, D. E, 10909
Pleistocene, Saint Elias Mts., northeastern: Denton, George H, 00691
**Zinc**
*United States*
Reserves, 1964, distribution by region: Everett, F. D, 00872